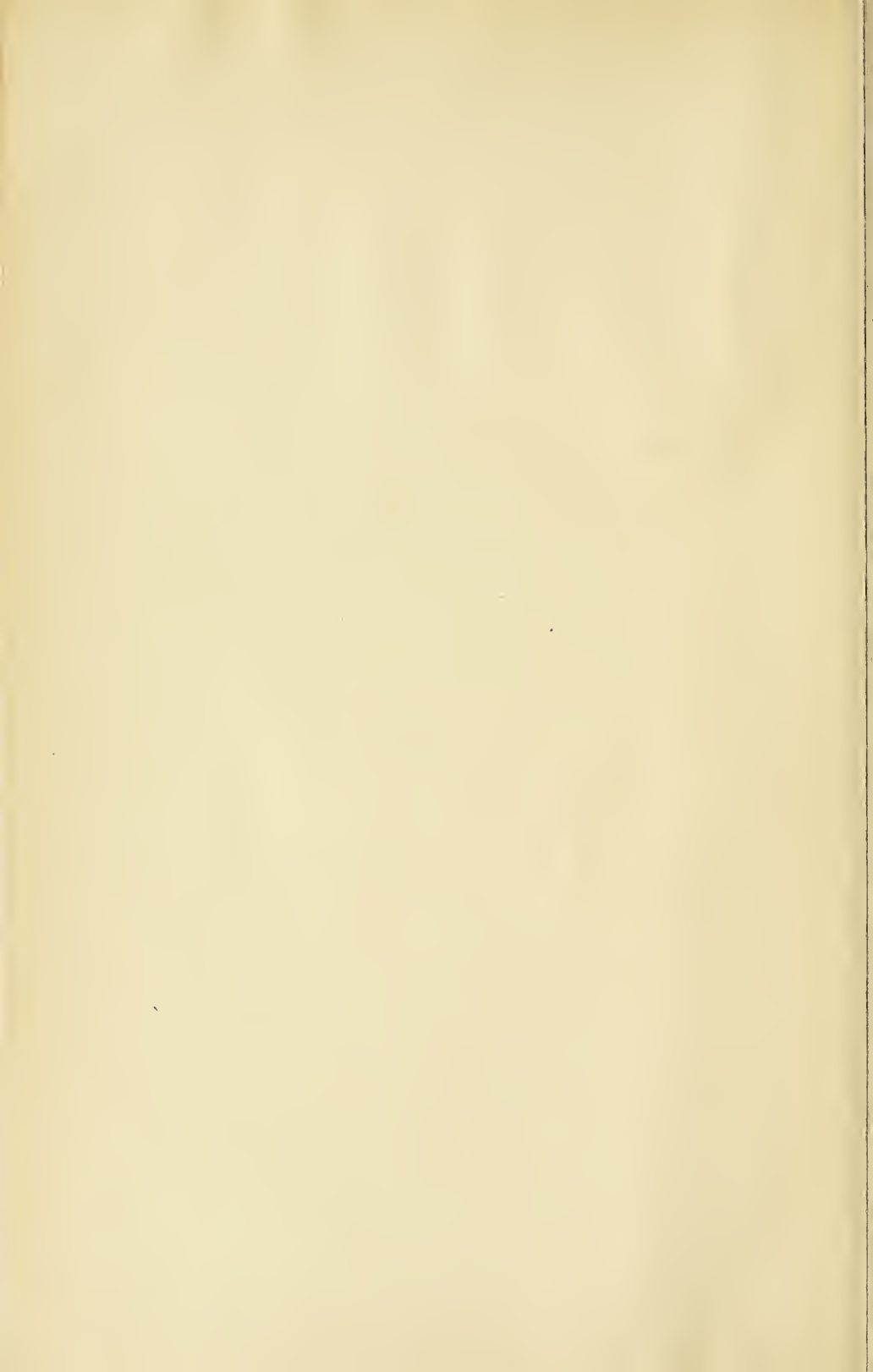
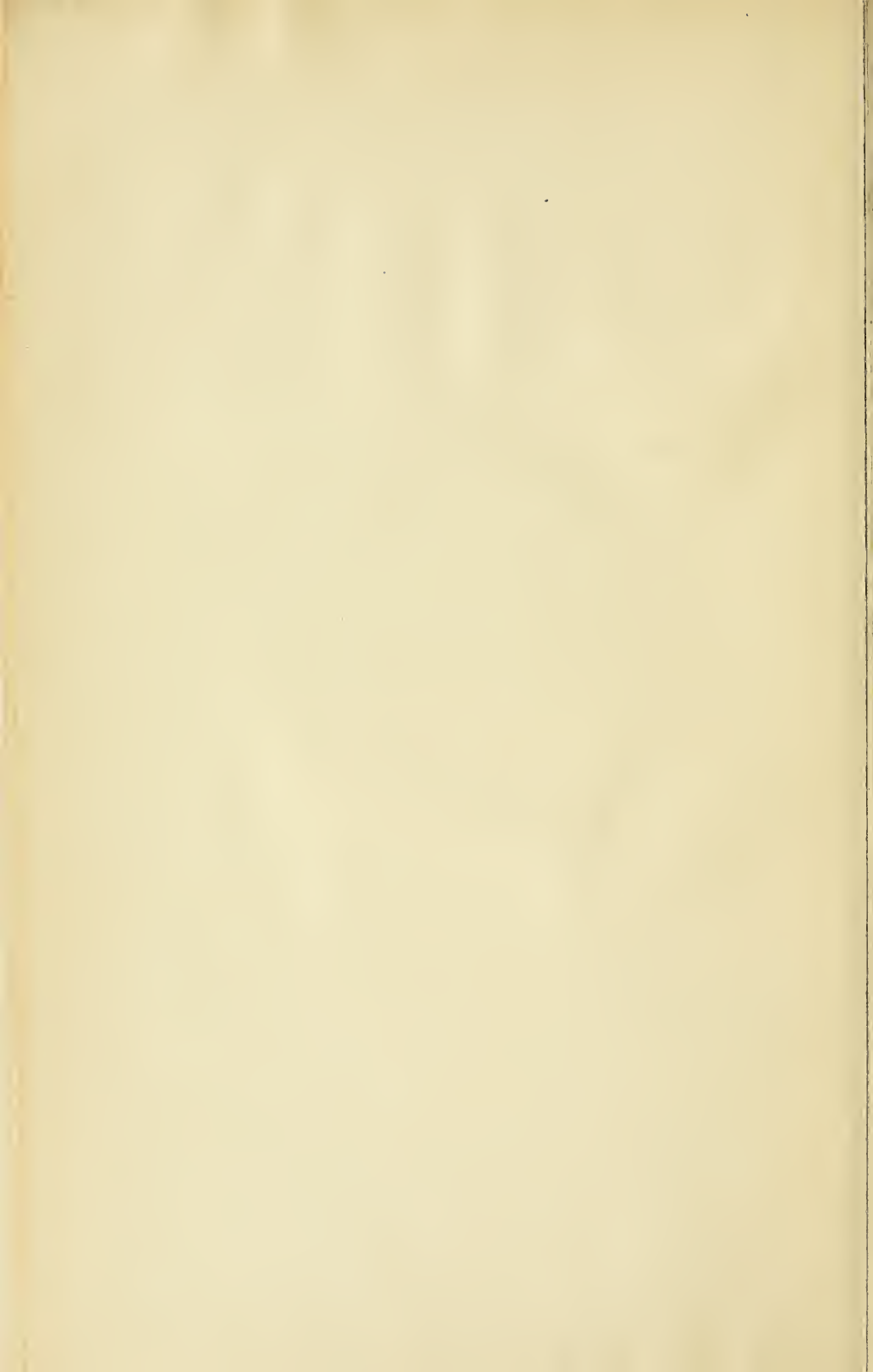








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H. H.

BULLETIN

OF THE

UNITED STATES NATIONAL MUSEUM.

No. 43.

A MONOGRAPH OF THE BATS OF NORTH AMERICA.

BY

HARRISON ALLEN, M. D.



WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1893.

ADVERTISEMENT.

This work (Bulletin No. 43) is one of a series of papers intended to illustrate the collections belonging to the United States, and constituting the National Museum, of which the Smithsonian Institution was placed in charge by the act of Congress of August 10, 1846.

The publications of the National Museum consist of two series—the Bulletin, of which this is No. 43, in continuous series, and the Proceedings, of which the sixteenth volume is now in press. A small edition of each paper in the Proceedings is distributed in pamphlet form to specialists in advance of the publication of the bound volume.

The Bulletin of the National Museum, the publication of which was commenced in 1875, consists of elaborate papers based upon the collections of the Museum reports of expeditions, etc., while the Proceedings facilitate the prompt publication of freshly-acquired facts relating to biology, anthropology, and geology, descriptions of restricted groups of animals and plants, the discussion of particular questions relative to the synonymy of species, and the diaries of minor expeditions.

Other papers of more general popular interest are printed in the Appendix to the Annual Report.

Full lists of the publications of the Museum may be found in the current catalogues of the publications of the Smithsonian Institution.

Papers intended for publication in the Proceedings and Bulletin of the National Museum are referred to the Committee on Publications, composed as follows: T. H. Bean (chairman), A. Howard Clark, R. E. Earll, Otis T. Mason, Leonhard Stejneger, Frederick W. True, and Lester F. Ward.

S. P. LANGLEY,

Secretary of the Smithsonian Institution.

WASHINGTON, D. C., *September 20th, 1893.*

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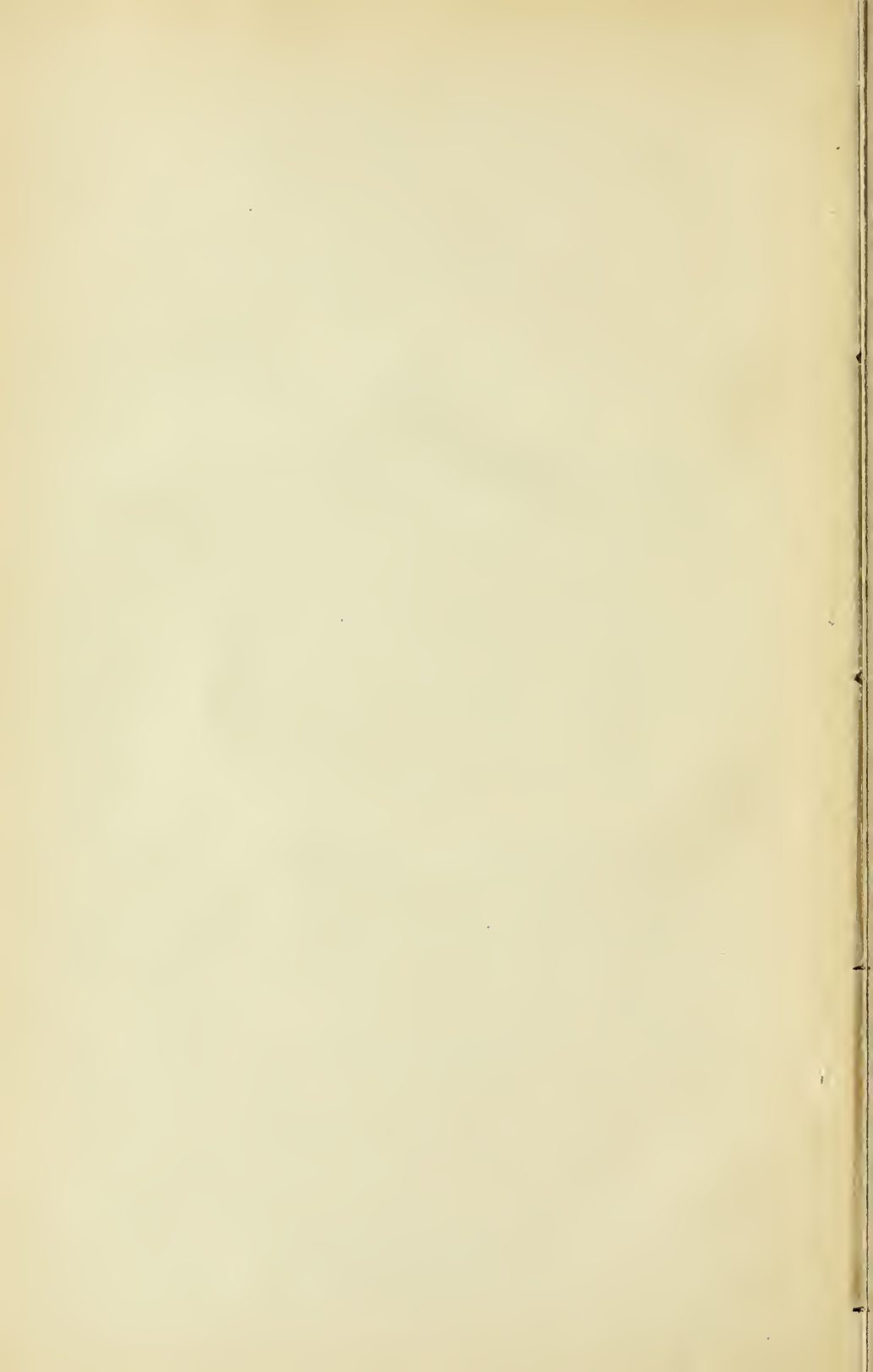
A MONOGRAPH OF THE BATS OF NORTH
AMERICA.

BY

HARRISON ALLEN, M. D.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.

1893.



P R E F A C E.

Nearly thirty years have passed since the Monograph of the North American Bats* appeared as one of the series of miscellaneous publications of the Smithsonian Institution. Imperfect as it was, this memoir has remained the single work on the subject. The influence of Prof. S. F. Baird is discernible throughout, and it is proper to say that the opinions of species therein entertained were accepted by him. But the changes in systematic zoölogy make it desirable that a new essay be written.

The monograph as it now appears is essentially new. It is not only larger by reason of the addition of species, but the descriptions are elaborated. Novel standards of comparison have been employed and many anatomical details included in the introduction.

The region occupied by the monograph (as in the original issue) is that of North America, extended to the south as far as the boundary line between the United States and Mexico.

Since 1864 two forms (*Euderma maculata* and *Atalapha teliotis*) have been discovered. Two tropical genera (*Artibeus* and *Promops*) and one species (*Vespertilio albesceus*) have been found to extend their northern movements so as to be included in the United States. The chief accessions have come in the form of geographical subspecies. Among these occur *Promops perotis californicus*, *Nyctinomus macrotis nevadensis*, *Vespertilio albesceus melanorhinus*, *Vespertilio albesceus affinis*, *Vespertilio albesceus exotis*, *Vespertilio nitidus ciliolabrum*, *Vespertilio nitidus macropus*, and *Vespertilio nitidus longicrus*.

In the accounts of the genera *Vespertilio* and *Nyctinomus*, which we know to range southward over extended areas, the work is confessedly incomplete, since the material available did not permit of comprehensive study. I felt indisposed to treat critically the descriptions of authors of forms, which, in my judgment, demanded careful comparisons of types and of extensive series of individuals. I can not pass judgment therefore upon the validity of the new species of *Nyctinomus* described by Dr. C. Hart Merriam (*Nyctinomus femorosaccus* and *Nyctinomus mohavensis*), nor of several new species of *Vespertilio* from Mexico which have been described by other authors.

*A Monograph of the Bats of North America. H. Allen, M. D., assistant surgeon U. S. Army, Washington, D. C., 1864.

The material used in revising the old monograph and bringing it up to date is for the most part that in the possession of the U. S. National Museum. Valuable aid was received by specimens examined from the collection of the Museum of Comparative Zoölogy of Harvard University; that of the American Museum of Natural History, New York; that of the Academy of Natural Sciences of Philadelphia; and that of the California Academy of Science. I desire to return my thanks to the officers of these institutions for courtesies extended. Dr. C. Hart Merriam, of the Agricultural Department, Washington, kindly sent me the entire valuable collection of the *Vespertilio* in his charge; and by so doing enabled me to study this difficult genus under the most favorable circumstances. Special acknowledgments are also due Mr. H. A. Ward, of Rochester, N. Y., who placed in my hands his entire collection of Chiroptera. I also wish to thank Mr. G. S. Miller, jr., of Cambridge, Mass.; Prof. J. H. Montgomery, of Meadville, Pa., and Dr. Robert W. Haynes, of Los Angeles, Cal., for valuable assistance.

All measurements are assumed to be in the French scale unless otherwise stated.

The measurements in English scale are taken from the monograph of 1864, together with lists of specimens which at that time formed the basis of the descriptions. These are copied for the convenience of readers who may not have access to that publication.

The figures have been drawn by Mr. F. von Iterson with a fidelity to the originals which can not fail to aid the student of a confessedly-difficult group of animals.

ABBREVIATIONS.

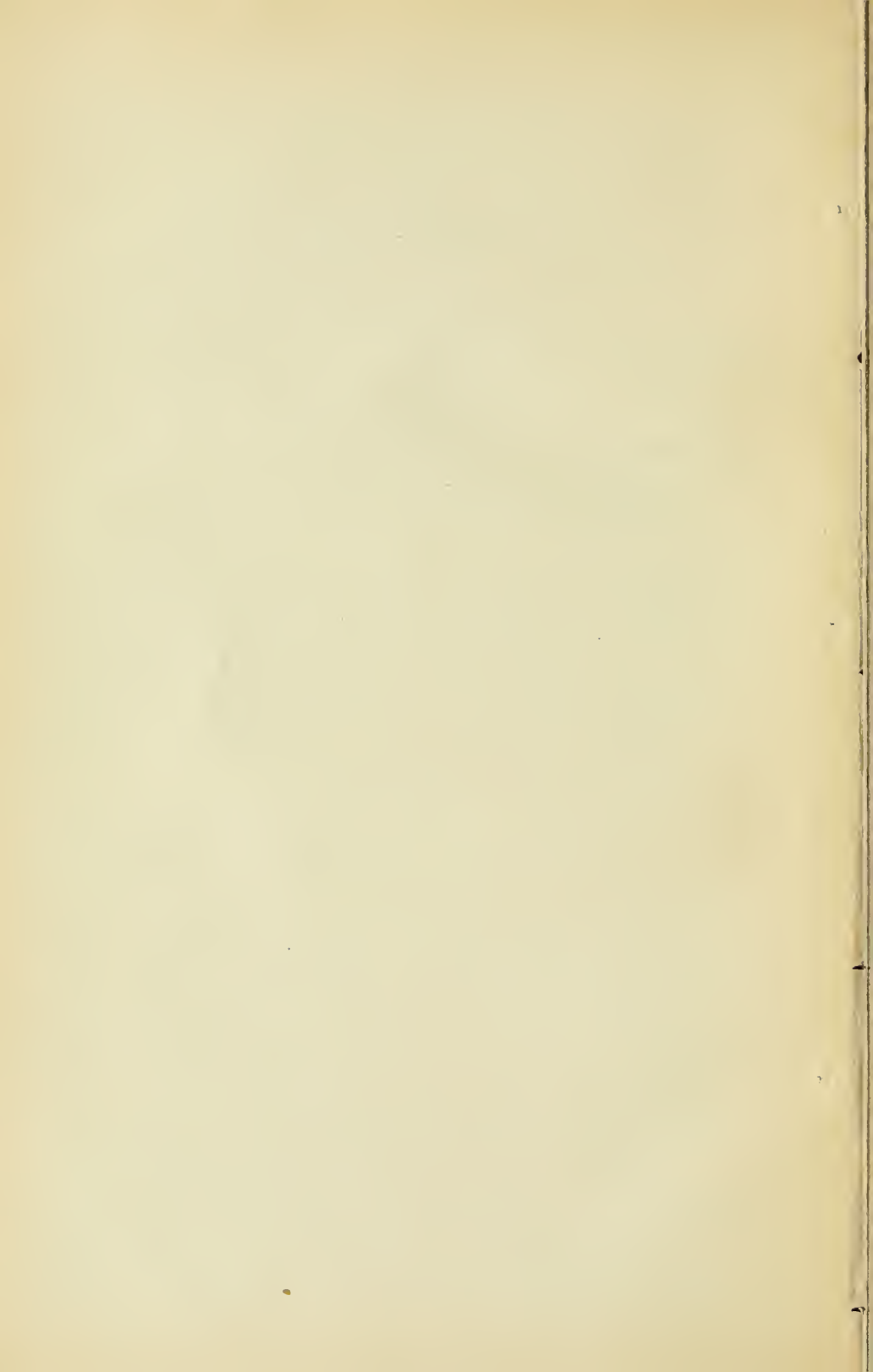
U. S. N. M.—United States National Museum.

A. N. S. P.—Academy of Natural Sciences of Philadelphia.

M. C. Z.—Museum of Comparative Zoölogy.

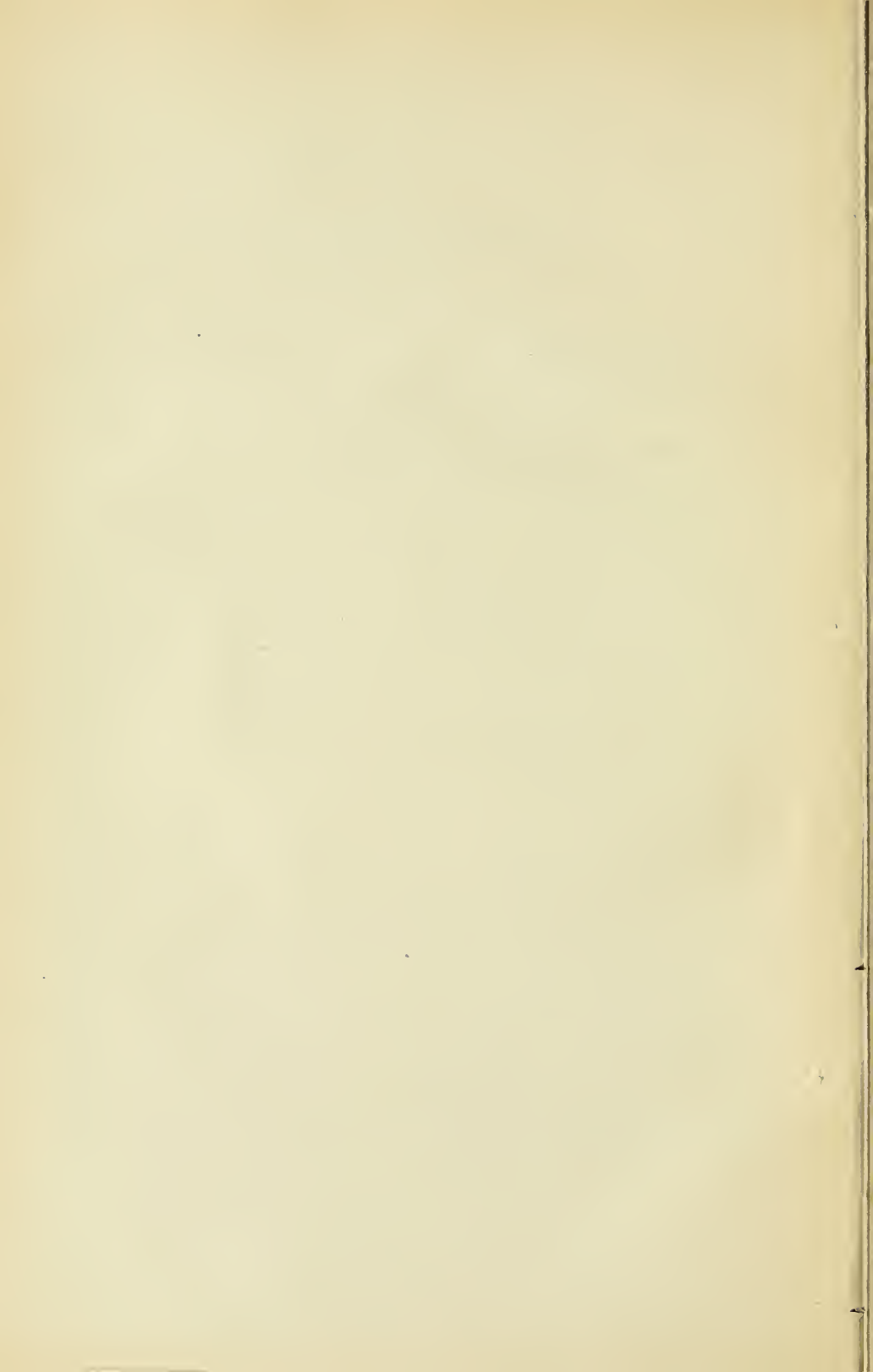
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A MONOGRAPH OF THE BATS OF NORTH AMERICA.

BY HARRISON ALLEN, M. D.

INTRODUCTION.

The bats constitute the order Chiroptera. Unlike related groups which are equally extensive, the bats do not vary in sufficient degree to be confounded by any possibility with other creatures. By an untrained observer shrews might be mistaken for mice or voles, some of the smaller marsupials for minks or weasels, conies for marmots. But the popular impression of a bat is accurate, since this creature is the only mammal adapted for true flight, and no other mammal resembles it. If any mammals exist or have existed that are half bats and half moles, half bats and half lemurs, half bats and half marmots, they are quite unknown to the naturalist. Paleontology is silent as to the origin of the bats, though comparison of their bony framework with those of the Insectivora, Lemuroidea, and Rodentia suggest that they may have arisen from the mammalian stem not far from the points at which the differentiation of these branches began.

MEMBRANES.

Let us examine the undissected bat, and endeavor to establish thereby general conceptions of the creature and of some of the signs of the superficialities by which its varieties can be named. It is at once seen that the anterior extremities are furnished with greatly elongated fingers, the intervals between which are occupied by two layers of skin. Goldsmith uses a happy phrase when he says "the fingers serve like masts that keep the canvas of a sail spread and regulate its motions." Layers of skin thus make up the wing membrane. They are continuous from the last finger and the thumb, or some adjacent surface, to the sides of the body, the neck (both above and below the arm and forearm), and the outer side of the posterior extremity. Each wing membrane reaches below the knee and from this point, in varying degrees, to the ankle and the foot. The space between the posterior extremities is also occupied, as a rule, by two adjoined layers of integument which constitutes the interfemoral membrane. This structure as opposed to the

above is less constant in form and dimensions. It may be guided by a long tail quite to its tip, it may allow the tip to project in different degrees beyond its free margin, it may greatly exceed in size that of the stunted tail, it may be defined as a hem along the inner border of the limbs, or it may be entirely absent.

It follows from these statements that all bats are provided with a back and a front skin-expanse from the sides of the body to the extremities in a constant manner, but from the tail to the posterior extremities in an inconstant manner, the last named presenting modifications determined by degrees of outgrowth of the tail itself.

The membranes present many details with respect to the manner of their attachment to the sides of the body and to the various parts of the limbs. Interesting variations of plan are seen where the skin crosses joints. In the elbow joint the skin may be attached entirely to the epicondyle, so that the joint lies quite to the under side of the wing, as in the African fox-bat, *Epomophorus*; or it may be attached midway, namely, to the olecranon, as in many forms, but perhaps best seen in the neotropical American *Saccopteryx*; or it may be attached entirely to the epitrochlea, so that the joint lies quite on the upper surface of the wing, as in *Rhinolophus pearsoni* and *Taphozous*. At the wrist distinctions are seen in the manner in which the tendons of the extensor carpi ulnaris and flexor carpi ulnaris are disposed at the angle which is formed between the radius and the fifth metacarpal bone. When this angle is marked, and skin-folds are conspicuous over the tendons named, a radio-metacarpal pouch is defined. The knee always lies on the upper surface of the membrane. It is most free in *Macrotus* and least so in the Molossi.* The membrane attached to the ankle may lie entirely to the hallucal side of the joint, but is disposed to cross it by an oblique raised fold and be secured to the minimal, *i. e.*, little toe side.

I have found it convenient to employ a number of names for the subdivisions of the dermal expanse.

The membrane which extends from the sides of the trunk to include the anterior extremity is the wing membrane ("bat wing," patagium).

The membrane between the legs is the interfemoral membrane (uropatagium).

The wing membrane above the arm and forearm is the prebraehium (antebrachial membrane, propatagium).

The wing membrane below the arm and forearm would become antibrachially the postbrachium. But since the postbrachium could not be separated from the sides of the trunk and the legs, it has been found necessary to discard it.

The part of the wing membrane lying between the body, the humerus,

*The group named the Molossi will be held in this essay to be distinct from the group of which *Emballonura* is the central genus. I am of the opinion that these alliances are distinct and coequal.

the lower extremity, and a hypothetical line drawn downward from the elbow and intersecting the free margin of the membrane, is the endopatagium.

The boundary at the elbow is often fixed by the vertical terminal branch of the triceps fasciæ system. The subordinate lines (probably platysmal in origin) in the endopatagium incline obliquely either toward the humerus or the trunk.

The part of the wing membrane which is limited by the line at the elbow as above given, by the forearm, and the fifth metacarpal bone and phalanges, is the mesopatagium.* Within the mesopatagium the subordinate lines incline either toward the forearm or the manus.

The part of the wing membrane limited to the manus becomes the ectopatagium (dactylo-patagium). The subdivisions of the ectopatagium are the first, second, third, and fourth interspaces. These are named from the pollex toward the quintus. The series of bones which is embraced in the metacarpal and phalangeal lines being conspicuous in the bat, it is desirable to possess a name in referring to each series taken as a whole. The name digit will be used for the rod of segments embracing the metacarpal element. The nerve which appears at the anterior margin of a digit becomes predigital, and that of the posterior margin, postdigital.

The cartilaginous tip to the terminal bony phalanx, respectively, of the third, fourth, and fifth fingers might receive the name of the third phalanx when three phalanges are present, and of the fourth phalanx when four phalanges are present.† The shapes of the terminal phalanges are of interest and some of these will be described.

I have examined a sufficient number of genera to suggest that an account of the markings of the wing membranes and of the shapes of the terminal phalanges enter into all discriminating studies.

The division of the wing membrane into the parts endopatagium, mesopatagium and ectopatagium is sustained by what is observed in *Taphozous mauritanus*, since in this species the endopatagium is of a dark color while the rest of the membrane is white, excepting the extreme tip of the end of the third finger. Now when the animal is at rest the surfaces above named are those only which are exposed to the light. In all young bats which cling to the mother, without exposing any other portions of the membrane than those named, it is evident that for a long period the endopatagium has functions which are not exacted of the rest of the wing membrane, and in consequence, in my judgment, it is easy to see how this portion of the wing expanse should be distinguished from those portions which are used only in flight.

*The endopatagium and mesopatagium are together the same as plagiopatagium of Kolenati. (Beitr. z. Naturgesch. der Europ. Chir., Dresden, 1857.)

†It must be acknowledged that the study of the embryos does not confirm the statement here made. In a word, the segmentation of the cartilage from the shaft of the bony phalanx remains a probability only.

The digits on their palmar aspect may be sharply defined as in the Phyllostomidae and *Corynorhinus*, or they may be obscured by the membrane or the upper part in the forepart of the hand, namely, in the region of the second, third, and fourth digits, as in Molossi, Vespertilionidae and the genus *Antrozous*. The membrane may lie chiefly on the upper aspect of the digits, as in most bats, or at the lower. That in the second interspace may be attached to the upper border of the second and to the lower border of the third metacarpal bone.

The skin is much more loose about the legs than the arms and on the interfemoral membrane than the wing membrane. The membranes are attached to the lower border of the first two or three caudal vertebrae, thus permitting them to be seen distinctly *above*, and to the upper borders of the remaining vertebrae, thus permitting them to be seen more distinctly *below*.

The skin of the two sides of the body unite in such wise as to permit a very narrow interval to exist between the two layers. The upper layer of the wing membrane is extending directly outward on a level with the back of the chest and of the loin, but the lower layer is variable. It may extend outward as in the upper layer, but a disposition exists for it first to conform to the curve of the side of the trunk and join the upper layer near the union of the side with the upper surface of the trunk. In one remarkable instance, *Chilonycteris davyi*, the under layer extends quite to the middle line of the back, and thence is deflected in an acute angle outward to join the upper layer. The region of the axilla is greatly depressed in bats, owing to the inclination for the under skin layer to extend upward and backward. This space is so large as to suggest the adaptation of the pouch thus formed for the protection of the young. In *Cheiromeles* it must have another significance, since it here constitutes a huge bag-like involution which extends as far as the middle line of the back.

THE WING MEMBRANE AT REST.

The bat when at rest folds the fingers by a movement of the root of the hand (carpus) downward on the wrist end (distal end) of the forearm. This movement is characteristic and when completed brings the fingers in a compact bundle (like the ribs of a closed umbrella) under the forearm and parallel to it. The hand is thus tucked up toward the rest of the anterior extremity, and as the forearm (in the same movement) is sharply flexed on the arm the entire extremity presents the greatest possible contrast to what it exhibited when prepared for flight. The bat now supports the body in one of two ways. It is prone, *i. e.*, with the front of the body downward on the plane of support, or it is pendant, *i. e.*, hung by the claws of the hind feet. If it is prone the base of the thumb and wrist supports the body and is furnished with a hardened pad of skin (callosity) for the purpose, the thumb being held at the same time well out of the way, and the posterior extremity taking

the position nearly the same as that of terrestrial quadrupeds. The best example of those that scurry* when the wings are folded are the Molossi. In this group the phalanges of the third and fourth digits are now no longer held in axial line with the metacarpals as in flight, but are drawn upward and to the side, though well out of the way. The tail in all prone forms remains extended and the tip touches the plane on which the animal rests. If the bat is pendant in rest the base of the thumb and wrist do not support. The thumb is without callosity, is more engaged in the wing membrane, and is drawn more or less in toward the under surface of the wing. In this event the foot is furnished with sharper and more recurved claws, since they are now prehensile. The leg assumes a position quite at variance with the terrestrial position and is different in this regard from all mammals, the sloth alone excepted. The tail in the pendant form, at least in our red bat, is drawn well forward and rests on the lower part of the trunk. It is readily seen that very long digits of the anterior extremity would be more or less in the way in the prone forms, while they might be extended to any degree in the pendant forms, without interference. In fact the first named have smaller digital elements than the last and the wing expanse is correspondingly more restricted.†

THE WING MEMBRANE IN FLIGHT.

While interesting characters are thus observed in the bat when at rest it is in the use of the limbs in flight that the chief peculiarities are noted. The intervals between the digits vary greatly in the different genera. As already remarked the under surfaces of the second and third digits are boldly outlined or are covered with membrane so as to obscure their outlines. In the forms in which this obscuring is noticed the fifth finger is supported by a little rod of cartilage.

The opening of the wing exerts a powerful influence over the posterior extremity. It pulls it outward in the forms in which an interfemoral membrane is present and thus makes tense this membrane. The entire limb is abducted from the terrestrial position and the foot is turned with its plantar surface forward.

The wing membrane may be said to be redundant when the expanse above the arm and forearm extends freely to the carpus and embraces

*A word was needed to express the terrestrial motion of a bat whose wings are at rest. I venture to use "scurry" in lieu of a better.

†The contrast between prone and pendant positions of bats when at rest is an instructive one. It supposes the existence of a number of adaptive characters, which will be observed in the accounts of members of our fauna. So little is known of the habits of bats that it would be premature to base any generalizations upon these or any other isolated groups of structural peculiarities. I have seen our common brown bat in captivity hang itself up by the claws, but have never seen it other than prone when at rest in its native haunts. I am also aware that *Rhynchonycteris* (which has a flexed thumb and a small pollical callosity) comes to rest like a moth; i. e., with wings expanded yet prone.

the small thumb to a point beyond the first phalanx of the thumb; when it extends down to the foot beyond an oblique muscle line which extends upward and outward from the lower part of the leg; when the space between the second and third digits is ample, and that between the thumb and second digit is provided with a well-defined hem of membrane.

Skin folds are often disposed along the lines represented by the palmar fascia, at the proximal end of the fifth digit.* The flexor tendons at the radio-digital angle are often covered with similar dispositions of the skin.

The membranes are supported not only by the parts of the skeletal frame-work, as these parts are usually defined, but by a number of special adaptations. An accessory cartilage at the somad margin of the terminal fifth digit has been already named (*Vespertilionidae*, except *Plecoti*).† The interfemoral membrane is supported at the free margin by a special cartilage (calcar) from the tarsus in all bats excepting the *Pteropidae*, *Rhinolophidae*, and the *stenodermata*. The calcar may have a process from its under margin, as in *Noctulinia noctula*. The terminal joint of the tail may be spatulate, as in *Nycteris*. Terminal cartilages of the third and fourth digits are present except in *Pteropidae*, *Rhinolophidae*, and *Emballonuridae*. They are of varying shapes, the whole arrangement having for its object the support of the free margin of the wing membrane. These cartilages, as a rule, are deflected outward, though they may remain axial, as in *Phyllostomidae* and *Plecoti*.

All things remaining the same, the degree of strain may be measured by the extent and variety of these special supports, and may be said to be in the line of specialization for aerial movements. Hence, in forms in which they are absent the membranes are broad and may be said to exhibit more of a parachute arrangement than in other types in which they are present, and the motion of the wings to be like that of a slow fanning rather than a rapid, varied flight.

Strain on the membranes is also shown in the angles formed between the portions of the wing farthest away from the body, namely, the region of the second and third digits. These are pulled away from the fourth and fifth digits, which remain nearly passive, by the traction of the muscles which extend these bones (*extensores carpi radiales longior et brevior*), and the whole membrane becomes tense. The contrast between the shapes of the wing in this regard is considerable when such forms as *Artibeus*, *Nyctinomus*, and *Atalapha* are compared.

When the wing of a bat is held up between the eye of the observer

* *Vespertilionidae* (excepting *Plecoti*), and *Molossi*.

† In the prodrome of this introductory essay (*Proc. U. S. Nat. Mus.* xvi, 1893) this cartilage is given as a character of the *Molossi*, while said to be absent in *Antrozous*. I have since corrected both of these statements. My first announcement respecting the accessory cartilage was made in *Proc. Acad. Nat. Sci. Phila.*, 1889, 330 (*note*).

and a bright light the membrane is seen to be translucent. The delicate connective tissue lines (trabeculae) are seen uniting the various parts of the bony framework, and the positions of the nerves, blood vessels, and muscle-fascicles are displayed. The paths of the nerves and blood vessels constitute one system and may be spoken of together, but the trabeculae and muscles are distinct from these and in some degree from each other. As in the case of the relation which exists between the skin and the bones, so in the arrangement of the parts just named the degrees of strain to which the wing is subjected account in the main for the difference in the various genera. The muscle-fascicles are most numerous in the membrane near the body, and are better developed in the narrow-pointed winged forms, such as *Molossi* and *Atalapha*, than in the broad, parachute-like forms.* The muscle element in the wing is especially weak in the *Pteropidae*, *Rhinolophidae* and *Vespertilionidae*.

The fibrous lines which extend across the membranes are not without system. Many of them are excessively attenuated tendons; such, for example, are the fibers of the palmar fascia, already mentioned. Others are the fibers which connect the joints of digits; more of them yet appear to be parts of a true derm. The nerves and blood vessels pursue the same courses. Since the directions of nerves are of more importance in morphological study than the vessels, the former will be alone named. In each interdigital space a nerve tends to enter at its proximal end and, dividing into two branches, incline along the sides of the opposed metacarpal bones. The departures from this plan are numerous, and are so constant in groups of generic and even specific limitation that they constitute valuable additions to diagnoses.

An oblique raised line passing down on the wing membrane from the upper part of the arm, in most bats, corresponds to the *coraco-brachialis fascicle*. It is least marked in highly aberrant forms, and may be of nerve origin, instead of muscular, in *Noctilio*, *Corynorhinus*, and *Plecotus*. A second, lying near the elbow, in like manner, is caused by a muscular slip from the triceps extensor and therefore becomes the *triceps fascicle*. In *Corynorhinus* and *Plecotus* this line is represented by one corresponding to a nerve, apparently ulnar, or the internal cutaneous. Both these lines are offshoots from the muscles named. The *intercostal lines* are those which pass directly from the sides of the trunk.

The wing membrane, when expanded, exhibits differences in the width of the interdigital spaces. These differences relate in an intimate manner with the behavior of the parts in flight, and consequently with habit. The subjoined table indicates some of these distinctions:

* Perhaps the highest degree of development of the muscle system is attained in *Rhinopoma*.

Manal (pteral) formulae of the widths of second, third, and fourth interspaces.

Species.	II.	III.	IV.	Fore-arm.	Difference between III and IV.
	mm.	mm.	mm.	mm.	mm.
Lophostoma.....	7	17	18	49	1
Schizostoma.....	3	16	21	32	5
Macrotus.....	2	15	22	44	7
Desmodus.....	2	21	37	53	10
Vampyrops.....	3	17	27	36	10
Chilonycteris.....	1½	15	17	40	12
Hemiderma.....	5	20	32	26	9-12
Vampyrus.....	16	41	53	105	12
Lonchoglossa.....	3	19	32	33	12
Monophyllus.....	3	17	34	32	14
Artibeus.....	4	21	39	51	18
Brachyphylla.....	3	25	43	64	18
Mormops.....	3	16	35	50	19
Phyllostoma.....	4	29	62	81	45
Rhynchonycteris.....	5	16	25	40	9
Cynopterus *.....	10	18	27	58	9
Vespertilio †.....	2	11	31	59	10
Epomophorus †.....	13	21	39	83	11
Rhinopoma.....	3	13	30	64	17
Molossus §.....	2½	5	35	46	30
Noctilio.....	2	13	58	83	45
Pteropus ||.....	18	17	69	145	52

* *C. marginatus*.

† *V. murinus*.

‡ *E. franqueti*.

§ *M. rufus*.

|| *P. edwardsii*.

This list is selected in the main for comparison in members of a single family, viz, the Phyllostomidae. The last eight forms are from families other than the one first named.

It is believed that these distinctions may be conveniently included in the characteristic proportions of bats.

In flight the thumb is extended in Vespertilionidae, but partially flexed in Phyllostomidae (excepting *Desmodus* and *Diphylla*) and in *Plecoti*. The degree of inclosure of the thumb in the membrane answers to the amplitude of the membranes generally and when extensive tends to draw the thumb slightly toward the palm, the space between the thumb and index finger being moderately occupied by a skin expansion.

It is a tendency under certain conditions for all growth processes to dominate functions other than those which are essential to their own activities. The best general conception of the manner of extending a fold of skin between the limbs is seen in the Batrachia. In the water newts a longitudinal ridge is often seen extending along the sides of the trunk. This is continuous along the hinder border of the anterior extremity (well developed in *Menopoma*) and reaches as far as the tip of the fifth digit. This fold is supplied by the ulnar nerve, which appears to be in its earliest expression a nerve for the skin of the posterior border of the forearm, of the fifth digit, and the muscles found in these regions. The phenomena of a fold of skin extending between the toes is one already familiar, so that the general plan of the skin expanse in a creature so low as the *Menopoma* prefigures that of so highly specialized a form as the bat without violence and without leaving a single line obscured. Difference of degree and not of kind separates them.

The very exceptional disposition in the bat for the skin from the trunk to extend the entire lengths of the limb, and in the case of the anterior extremity to form enormous webs between the produced digits, is associated with an inclination for the ears to become greatly expanded and for entaneous offshoots to appear at the muzzle, chin, and the sides of the face. Even the prepuce is disposed to be redundant. Together with this inclination, dermal structures are highly specialized, so that the sebaceous glands, hair follicles, and tactile bodies are well developed. It can be readily surmised that special adaptations for a variety of purposes occur in this group of structures, so that secondary sexual characters are found in the gland masses of the skin of the neck, and of the skin folds, the details in the ears, the pouches of skin, etc., are available for purposes of classification.

THE EXTERNAL EAR.

In this connection let us glance at the peculiarities of the external ear. The external ear is markedly modified from the type usual in quadrupeds. Its simplest expression is seen in the Pteropidae and the Rhinolophidae. In these families the widely separated auricular cartilages are closely enwrapped by integument and the tragus is said to be absent. (See below.) In such an ear the terms *inner* and *outer borders* and *tip*, exhaust the list which are demanded in their description. In the ears of the remaining families it is far different. The auricle here is expanded to degrees which bring the outer parts to a greater or less degree downward and forward on the upper parts of the neck and reach the region of the mouth, or even the chin, while the inner border, being guarded by a skin fold which connects the ear to the crown, is disposed to be united with the corresponding part of the ear of the opposite side and extend in varying degrees toward the snout. Skin lappets arise from both inner and outer borders. Those from the inner border form a long appendage which lies in advance as defined in the simple ear and becomes the *internal hem*. As a rule it ends as a free lobe inferiorly, which thus becomes the *internal basal lobe*. The line of the true internal border being always discernible becomes the *internal ridge*. The external border, which is distinguished from the true external border which now becomes the external ridge is also disposed to form a hem (*external hem*), which, however, in contrast to the inner is apt to be divided into an upper and a lower part; the upper part forms the *first scallop*, and the lower the *second scallop*. The free lower end of the outer border becomes the *external basal lobe*, which may be separated from the lower scallop by a deep *basal notch*, or the second scallop may extend across this notch and the external basal lobe and becomes continuous at various distances with the face or that over the lower jaw. These parts will not receive distinctive names. In most examples the auricle is also conveniently divided into an anterior and a posterior part, the anterior part is marked, if marked at all, by lines repeating

that of the internal border, while the posterior part is marked, if marked at all, by conspicuous transverse lines or striae. The hair when it extends upward on the ear from the crown is usually of the color and character of that of the crown, while that of the posterior is of the color and character of that of the neck.

The *tragus* varies exceedingly in form. The following terms are employed in its description, viz, the *inner* and *outer border*, the *tip*, the *notch*, which is near the base of the outer border, and the *basal lobe*, which lies below the notch. The tragus is said to be absent in Pteropidae and Rhinolophidae, but in some examples of the family last named a rudimental tragus can be discerned. The tragus always arises from the ridge which lies in front of the auditory meatus and connects the inner and outer auricular borders. It is of interest to observe that while this connection with the borders is imperfectly defined in most bats that in the recently discovered *Euderma* it is markedly so united and tends to constrict the basal parts of the enormous auricle.

Not only is this the case, but the ears are often united by a band (*inter auricular membrane*) which extends obliquely forward. In *Corynorhinus* and *Macrotus* it is on the face, and in *Promops perotis* reaches quite to the snout.

In illustration of the value of the ear in classification the following table is drawn up from the members of the bats described in this memoir.

Phyllostomidae.—External ear without internal basal lobe. External ridge rudimental or absent. External basal lobe not marginal, but lies well within the large second scallop, which is continued well in front; tragus prorect, coarsely crenulate or spinose on outer border.

Molossi.—Ear without internal basal lobe. Internal ridge produced forming a "keel." External ridge marginal, produced, bounding external basal lobe. External basal notch open, *i. e.*, not covered by lower scallop; tragus rudimental.

Vespertilionidae.—Ear with internal basal lobe. Internal and external ridges rudimental, not produced. External basal lobe marginal (except *Plecoti*), not touching external basal ridge. External basal notch occupied by produced lower scallop. Tragus obscurely crenulate on outer border, or smooth.

SECONDARY SKIN DEVELOPMENTS.

At the muzzle the skin folds are median and lateral. The margins of the nostrils expand above and at the outer side while they are separated by a groove or a ridge in the middle line, as is seen in *Brachyphylla* and *Nyctinomus*. Or the two lines of perinarial expansion may meet below in the space between the nostrils and the lip to form a swollen ridge as in *Glossophaga* or a lappet as in most *Vampyri*, while the internarial ridge is continuous with a vertical leaflet. This is the

type seen in most of the Phyllostomidae as exemplified in this memoir in *Artibeus* and *Macrotus*. The nostrils may remain simple with the upper border advanced upon lumen of the opening so as to divide it into two cornua as in most Vespertilionidae or the lumen may be oval as in *Euderma*.

In all the genera in which the foliations about the nostrils are well developed the outgrowths occur in positions of structures which can be named in the muzzles of other mammals. Thus in *Rhinolophus* (and at least in *Hipposideros*, so far as examined) the upper or inner margin of each nostril leads to the development of a fold (supra-narial) which by uniting with its fellow forms the anterior of the two ascending leaflets or the sella; the lower or outer margin leads to the development of the lateral fold (infra-narial), which passes back to form the lateral margin of the posterior ascending leaflet or the terminal leaflet; the muzzle glands are continuous posteriorly, with a short skin-fold which joins with the lateral fold to form the terminal leaflet. The supra-narial also joins the terminal leaflet from in front. The three plications end on the terminal leaflet at the part where it frees itself from the head. Various supplemental folds occur in *Hipposideros*, none of which, however, disturb the plan. The scheme described for *Artibeus* is essentially the same, excepting in the fact that a single ascending leaflet is formed, to which both supra narial and infra-narial folds contribute. In *Ectophylla* the entire muzzle-gland series becomes foliate, thus exhibiting a complete development of a tendency announced in *Rhinolophus*. In *Nycteris* the supra and infra narials do not assist in forming a median structure, but remain well out on the side of the face.

The lower lip is firmly held to the gum of the lower incisor teeth, as in *Vespertilio*, or it is free and forms a protrusile, membranous fold as in *Atalapha*. It may be entire or divided in the center so as to form two chin plates as in *Macrotus* and, as a variation, in *Nycticejus*. In *Atalapha* a distinct lappet extends entirely across the chin and in degrees of development distinguishes the sexes. The chin itself and the space directly back of it is adorned with scattered warts in all forms, but in *Phyllostomidae*, as shown in *Artibeus*, the entire chin is conspicuously adorned with verruce arranged in median and lateral groups. In *Chilonycteris* and *Mormops* these are the sites of curiously complex leaflets.

The sides of the face are furnished with skin-folds of various lengths, which are continuous with the external border of the auricle, or a large wart lies directly back of or below the angle of the mouth, while the sides of the muzzle are apt to be more or less thickened by swollen gland-masses, which tend to embrace the side of the nose-leaf as in *Artibeus* and *Macrotus*, or ascend toward the vertex of the face, where they either approach each other on the top of the muzzle as in *Antrozous*, or end free as in *Corynorhinus*.

THE HAIR.

The hair of the body is arranged in regions having well-defined boundaries. The crown of the head, the region directly in front of the ear, the neck, especially the side and back, inclusive of a line across the top of the chest, the shoulder itself, the sides of the under surface of the body, the rump, and pubis are all regions which are often separately colored, or clothed with hair of distinct texture, or rate of development than that of the other portions of the body. The sides of the neck are always furnished with longer hair than is the front and ordinarily than is the back. The hair of the pubis is more woolly than that seen elsewhere. The hair extends farther on the dorsum of the face in *Vespertilio* than in most genera. The same region is naked in *Adelonycteris*. The shoulders are occasionally furnished with shades of color contrasting with that of the rest of the body.

The membranes are clothed with hair in varying degrees. The greater area is naked. The interfemoral membrane is more thickly clothed on the upper than the lower surface, a tendency reaching its maximum in *Atalapha*, while the lower surface of the wing membrane between the body and the border of the manus—a tendency also marked in *Atalapha*, but most marked in the Asiatic form of the noctule bat (*Noctulina noctula lasiopterus*). As a rule the fur from the under surface of the body extends from the upper third or half of the arm to the knee. The presence of a clump of hair on the dorsum of the forearm is a good peripheral character for *Atalapha cinerea*. The interfemoral membrane as a rule is covered with an extension of hair from the rump to the basal third in Vespertilionidæ. In *Vespertilio* an interesting character is noted in the clump, not being well defined, but straggles downward in an irregular manner and is lost near the ankle. This disposition is especially developed in *Vespertilio capaccini* and in the Nevadan variety of *Vespertilio nitidus ciliolabrum*. The lower border of the membrane is constantly fringed in some forms of *Vespertilio*, but as an individual variation in the North American species. It is rare to have the lower border of the wing membrane from the foot to the manus fringed as in *Pteropus*, but *Vespertilio*, as seen in North America exhibits a singularly constant, minute bristle which overlies the membrane at the tip of the fifth finger. The ears are apt to be sparsely haired on the inner surface near the anterior border, on the outer surface at the basal third or half, and on the external basal lobe. On the whole the bats which take the prone position in rest are less heavily furred than those which are pendent. In one of the most marked forms of the former group (*Cheiromeles*) the skin is nearly naked. Interesting contrasts can be made in this way between the haunters of caves, attics, and old tree trunks and those which are caught hanging from the smaller branches and twigs of trees and bushes.

Bristles (setæ) usually surmount warts (verrucae). They are best developed on the face of Molossi, though they may be found in the group

last named on the upper surface of the interfemoral membrane. The very long hairs of the sides of the muzzle, which are so conspicuous in many of the small mammals of other orders, notably the Rodentia and Carnivora are absent. The best examples are met with in *Vespertilio* and *Chocronycteris*. Fringes of bristles adorn the margins of the toes in Molossi.

In describing bats in this manner the attention which has been given to the details of the coloring and the markings on membranes require an exact use of terms.

When hair arises from the membrane it will be seen that the clumps follow the directions of the trabeculae and are detected in the translucent wing as minute black dots arranged in rows. These must not be confounded with pigment spots which dot the naked spaces of the wing in some species.

GLANDS.

The skin glands are best developed on the sides of the face directly back of the muzzle. In Molossi a large, median, coarse sebaceous gland lies depressed on the under surface of the neck. It is best developed in the male. An elevated thoracic medianly placed gland is present in *Ametrida*. The mammae are large during the lactating period when the nipples are projecting and the areolar space naked. At other times the nipple disappears and the gland is reduced to the smallest possible proportions. In *Saccopteryx* and its allies the wing membrane above the anterior extremity is furnished with a sack which is lined with folds which yield a fetid secretion. The position and size of this sack furnish excellent characters to distinguish genera as well as sexes of individuals.

COLORATION.

It is necessary to state that the colors for the most part are described from alcoholic specimens which have been removed from the spirit and permitted to dry. Mr. F. W. True writes in the Smithsonian Report for 1888 that alcohol disturbs the color-scheme of a mammal. The character of alcohol is not especially here named and the remark is undoubtedly correct for specimens which have been preserved in wood spirit. However, none of the specimens used for this study have been preserved in other than commercial alcohol which has been variously diluted with water. I have observed no differences of the kind named between the few living individuals I have seen, the fur of the dried skin prepared in the usual way with arsenic and in skins dried after prolonged immersion in commercial spirit. It must also be remembered that since all the material available has been preserved in the same medium the comparisons are sufficiently exact for purposes of identification of museum alcoholics. It is barely possible that the color description may require modification as contrasted with that based upon living specimens.

THE SKELETON.

The skull.—In describing the skull in bats, I have borne in mind that the form of the brain gives expression to the shape of the brain-case to a far greater degree than is the case in other mammals. The divisions of the brain are readily outlined externally, and yield convenient boundaries, since the shapes of associated parts harmonize in some degree to them. Thus the region of the proëncephalon, of the mesencephalon, and of the metencephalon are defined. In like manner the impressions made by the lines of attachment of the temporal and masseter muscles, the former on the cranium, the latter on the lower jaw, are valuable. For the temporal muscles I have named the median line between the two the *sagittal crest*, or line, and the anterior and posterior temporal impressions the *anterior* and *posterior temporal ridges*, or lines.

On the under surface of the skull the size and direction of the process (sphenoidal tongue) which extends backward and outward from the basisphenoid is worthy of notice. As compared to other mammals, the cochlea is unusually large at the base of the skull, and is, as a rule, but partially concealed by the tympanic bone.

The otic capsule varies in the degree in which bony laminæ occupy the spaces created by the semicircular canals. On the side of the skull the surface (opisthotic) which adjoins the squama in mammals generally is in bats crossed by a process of the squama uniting with one from the exoccipital, as in *Atalapha*, or the surface is free as in *Nyctinomus*. The old-world genus *Hipposideros* resembles *Nyctinomus* in this particular. When the otic capsule falls out, as it is apt to do in the over-macerated skull, a foramen or a notch is always defined between the squama and the occipital bone. Sometimes a foramen of the same significance, viz, one occupied by the opisthotic during life, is seen on the occiput.

The otic capsule in Pteropidæ alone is inclosed in bone, to form a triangular wedge comparable to the *os petrosa* of other mammals. As a rule, the form of the cochlea and semicircular canals are outlined as though in the human skull the encapsuling petrosal bone had been chiseled away; the degrees in which thin plates of bone fill in the semicircular canals being alone subject to change. The horizontal loop in all forms examined is filled with bone.

The following scheme of the otic elements will be found useful:

External loop entirely occupied with bone:

Superior loop angulated, open.....	<i>Artibeus</i> .
Superior loop nearly filled.....	<i>Nyctinomus</i> (<i>N. brasiliensis</i>).
Superior loop about half filled.....	<i>Atalapha</i> .

External loop almost entirely occupied with bone:

<i>Antrozous</i> .
<i>Vespertilio</i> .
<i>Adclonycteris</i> (<i>A. fuscus</i>).

External loop and superior loops not occupied with bone:

Noctilio.

Macrotus (occasionally excepted).

Hemiderma.

Chilonycteris.

The tympanic bone is sometimes incomplete, as in *Vespertilio*, at its upper are, where it limits the zona tympanica superiorly. The bone constitutes the bulla, which presents various degrees of extension over the cochlea or forward along the side of the glenoid fossa. The width of the origin of the sterno-mastoid muscle is much greater than in mammalia generally. This interval in *Artibeus* equals one-seventh of the greatest length of the skull, while in *Canis* it equals one-nineteenth.

Seen from above, the face is described as forming a *vertex*. This extends from the region of the proencephalon to the upper border of the anterior nasal aperture. On the side the region of the face is equal to the length of the dental series. The orbit is, strictly speaking, that portion of the skull which accommodates the eyeball; but this is much smaller than the space as defined by the bony limits, as seen in many other mammals. Since custom has sanctioned an acceptance of an *orbital region* which would be limited posteriorly if a process were present extending from the anterior temporal ridge toward the zygoma, a similar region so restricted is held to be a valid one in all bats. In some genera, indeed, as those of the Emballonuridae, the post-orbital process is constantly present, and in the Pteropidae varying degrees of posterior limitations of the orbital region are seen. The face, including a part of the frontal bone, is inflated at the side in bats. I have called this the *fronto-maxillary inflation*. It forms a ridge or swelling at the upper border of the orbit. The inflation of the skull at the anterior part of the frontal bone to form the frontal sinus is much less conspicuous in the Cheiroptera than in some other orders, but the maxillary inflation is greater. This peculiarity gives the face a broad effect at its junction with the brain-case and modifies the shape of the orbit. The *ethmoidal plates* variously change the shape of the inner wall. As a rule, the frontal bone here permits the ectoturbinal parts to be in part defined. The region of the lachrymal bone appears to resist the disposition to inflation; hence the peculiarities of the inflation give character to this portion of the cranium. On the vertex the inflation causes the face to widen from the proencephalon to near the anterior nasal aperture, where it is abruptly narrowed, and to create depressions of inconstant kinds in the line of the conjoined nasal bones. The extent to which the recession of the nasal bone from the anterior nasal aperture occurs, as well as of the palatal notch, due to the rudimentary state of the premaxillae, afford bases for some characters of minor value. The length of the infra-orbital canal and the peculiarities of the outer wall of the canal are of interest. In *Artibeus* the canal is long and for the

most part smooth externally, as in *Canis*, while in the fauna generally it is short, as in *Felis*, and the outer wall is often elevated.

The hard palate may be either in the main axis of the skull, as in most forms, or deflected upward and forward. The characters furnished by the pterygoid processes, the palatal plates, are here as useful as in other mammalian groups. The premaxillæ are rarely firmly united to one another. When they are so united, as in Phyllostomidæ and Molossi, the median incisors are disposed to be contiguous. When they are not united, a large median interspace separates them and is continuous with the vacuity which in other mammals represent the incisorial foramen. The presence or absence of the spheno-palatine foramen is used in some groups, as Molossi and in Plecoti, in separating genera. The disposition of the turbinals is also of interest, the peculiarities of the arrangement being definitive of the families as established on other structural characters. If in mammals generally an outer and an inner turbinal group is recognized, then in the bats we have a median lamina which bears upon its inner surface one or more scrolls (endoturbinals), and an outer lamina with much simpler accessories (ectoturbinals). The simplest arrangement of the turbinals is seen in the Nycteridæ and Rhinolophidæ, the most complex in Pteropidæ. In *Natalus* alone is the ectoturbinal rudimental or absent. (Bull. Mus. Comp. Zoöl., Feb., 1880.)

In addition to the peculiarities of the masseteric impression on the lower jaw, already noticed, characters are furnished in the height of the coronoid process and the degree of deflection as well as the size and shape of the angle. The post-symphysal spine which is conspicuous in some extinct forms has not been seen by me in any of the extant forms (*Promops* perhaps excepted), and I have examined most of the genera of the order.

The shortening of the face, *pari passu*, with reduction of teeth, is seen in Carnivora. The tendency is seen in *Vesperugo*, and in bats generally. In *Vespertilio* the shortening of face is accompanied by displacement inward of the premolars. In a mechanical sense it amounts to the same as reduction in number. In pteropine bats a remarkable persistence of facial length remains, while the disposition to reduction is evident. One may conclude from the instance last named that the shortening of face and reduction of teeth are independent. The same is true of the Ungulata.

In *Atalapha* the lower jaw closes in front of the upper. The lower canines articulate with the anterior surfaces of the upper laterals their entire length. The upper canines are free, *i. e.*, do not articulate with anything.

Vertebral column.—The vertebral column is without large processes other than the hæmophyses which are well developed in the cervical region.

The *atlas* is broadest in Pteropidæ. In both *Pteropus* and *Epomoph-*

orus the bone extends downward posteriorly and at the sides so as to conceal the lower opening of the canal for the vertebral canal. The upper border of the conjoined laminae is boldly rugose. In *Artibeus*, a member of a group in the New World analogous to the foregoing, the atlas is greatly reduced in the proportions of the laminae and the transverse process, the lower opening of the canal for the vertebral canal is exposed on the posterior aspect of the bone, while the upper border of the conjoined laminae is scarcely rugose. In the vespertilionines, molossines, and phyllostomines minor peculiarities distinguish the atlas. These are given in the diagnosis of genera and species. In a general way it may be said that the pteropines are broadly separated from all the other bats by the characters presented by this bone. In *Pteropus* and *Epomophorus* the *axis* possesses a large neural spine which almost equals the length of the body inclusive of the cylindroid odontoid process. In *Artibeus* the spine is but one-half the length of the body, inclusive of the tubercle-like odontoid process. The remaining portion of the cervical is curved more or less antero posteriorly. This is less marked in the pteropine and phyllostomine genera than in the vespertilionine, where the curve is so great as to bring the occiput almost to the first dorsal vertebra. The *sacrum*, at its upper portion, exhibits a compressed projecting ventral surface. The spinous processes are flat, distinct, and increase in size from above downward in molossines and *Atalapha*, but they are low and confluent in many forms as in the pteropines. The first coccygeal vertebra in tailed forms is large and resembles those of the sacrum. The *caudal vertebrae* below this are cylindroid. They vary greatly in length, especially at the beginning of the series.

Ribs.—The first and second ribs are flat and broad (coalescent in *Natalus* and *Hipposideros*), but as a rule have a wide interspace. The other interspaces are also well defined in Pteropidae, but are often narrow, and in *Natalus* and *Hipposideros* are practically obliterated. The costal cartilages are relatively inelastic and are disposed to become early calcified. Indeed, the entire chest is rigid, and the ribs often become ankylosed to the spine, and in some forms, as in old individuals of *Vespertilio murinus*, the contiguous ribs to each other. Hence the respiratory movements are for the most part performed by the diaphragm and the flank muscles.

Sternum.—The prosternum is broad and massive, while both the mesosternum and metasternum are narrowed. The prosternum sends a conspicuous process forward into the neck (as in many terrestrial mammals) in molossines; all the others are without this process. The first joint is usually conspicuously keeled, and in Pteropidae this keel is divided by a deep notch. The mesosternum in the same family is also keeled its entire length, but in the other groups it is barely ridged or smooth.

Anterior limb.—The *clavicle* is present in all bats. It is firmly attached at both the acromial and the sternal end. The last named

effects an important articulation with the cartilage of the first rib and in the sterno-claviculo-costal joint; in Molossi, at least, it is of enormous strength. The *scapula*, as in other clavicate forms, with few exceptions, in which the large anterior extremity is not supported on the ground, possesses an infraspinatus fossa very much larger than the supraspinatus. The bone lies well up on the side of the neck in the forms in which the cervical series of vertebræ is bent forward. Excellent characters are yielded by the coracoid process. It is always long and slender, simple, and gently curved in various arcs in Pteropidae, Rhinolophidae, Emballonuridae, and Phyllostomidae, but bifid in most Vespertilionidae. It is interesting to find the genus *Vespertilio* aberrant in this respect, the process being simple and curved quite as in the larger groups first named. The posterior tubercle is prolonged to form an oblique posteriorly-directed process in *Lasionycteris*, and the molossines *Atalapha* and *Chalinolobus*.

With the exception of the tuberosities of the *humerus* no check processes exist anywhere in the bones of the limbs, thus presenting marked contrasts with the limbs of birds. The trochlear end of the *humerus* yields in the shape and direction of the epitrochlea valuable characters. This process conforms to the terrestrial type, *i. e.*, it is transversely inclined in pteropines and the genus *Saccopteryx*; is deflected downward parallel or nearly so to the shaft in phyllostomines and molossines, but is absent in vespertilionines. In vespertilionines again the articular surface is axial, *i. e.*, is in the middle line of the *humerus*, but in phyllostomines it is thrown well off to the outer side. Narrow-winged forms, as the molossines and the genus *Atalapha*, exhibit large tubercles on the *humerus* and wide trochlear surfaces. Thus these characters harmonize with rapid flight. On the other hand, the forms with smaller tubercles and narrow, poorly defined trochlear surfaces have broad wings and presumably slow flight.

The *radius* constitutes the main support of the forearm and presents few variations from a single type. As a rule it is nearly straight, but is much bent in *Hipposideros*. It is always obliquely grooved by the tendon of the extensor ossi metacarpi pollicis. The size of the large, deep fossa for the insertion of the biceps flexor is variable. Since the *ulna* does not enter into the composition of the anterior arc of the trochlea, and its place is here taken by the *radius* in addition to the work this bone does in articulating with the *humerus* at its outer half, it is easily seen that the *radius* is provided with two facets at its proximal end, and that the main ridge on the distal articular surface of the *humerus* fits in between these two radial facets. So far as the degree of invasion of the *radius* into the trochlea has been noted it appears to correlate with the degree of activity of the prone form in scurrying. It is thus marked in *Cheiromeles* and *Molossus*, and is small in *Kerivoula*.

The *ulna* is more inconstant in form than the *radius*; in all it is in-

complete and is composed of a proximal and a distal rudiment. The proximal rudiment is free at the weak olecranon, which resembles the parts in the sloth, and is continuous in most genera with an arched rod-like shaft of uniform width, which is ossified, as a rule, with the radius at about its proximal third. Exceptions are noted to this arrangement in some of the vespertilionine genera, *e. g.*, *Scotophilus* and *Miniopterus*, as well as in the molossine *Promops*, in which a small ankylosed olecranon unites by a filiform shaft to the proximal third of the ulna. But the vespertilionine forms as a rule (*Harpiocephalus* not examined) retain a free olecranon which is continuous with a filiform tapering shaft, which ends free in the muscles of the forearm. *Corynorhinus*, *Nyctophilus*, *Chalinolobus* are exceptions even to this arrangement, for here the shaft is entirely absent, the rudimental fixed olecranon constituting the entire proximal end. The tendon of the triceps muscle as it is inserted into the ulna is occupied by a sesamoid bone. No other animals possess a bone in this situation. It is either a separate ossicle developed in the tendon, or the disjuncted epiphysis of the ulna. This relatively unimportant bone receives the muscle which alone extends the powerful forearm. The extensor carpi ulnar is a muscle as constant in this group as in others—arises from it. All the relations of the ulna, therefore, are with the extensors. The distal end is ankylosed to the radius at the wrist. The form may be that of a quadrate plate, more or less well defined, which is usually entire, though it may retain a minute foramen of insufficiency, as a rule, in the vespertilionines and molossines. The plate may be absent when a hook-like process directed proximally, as in *Atalapha*; it may project nearly at right angles to shaft and be conoidal, as in phyllostomines, rhinolophines, and the genera *Saccopteryx* and *Natalus*; or it may be absent, as in the pteropines.

The *carpus* of bats exhibits some valuable characters. In all forms the first row of bones is composed of two bones only—viz, a large bone which constitutes the greater part of the row and will here receive the name of the scapho-lunar, and a small separate bone at the ulna border of the scapho-lunar which appears to be the cuneiform.

The second row is composed of the trapezium, trapezoid, os magnum, unciform, and often the pisiform. The os magnum and unciform always unite to form a convex surface for articulation with the second row. With the exception of the pisiform all these integers are easily recognized. The carpus on the whole is simple, since the first, second, and third metacarpal bones are in axial articulation with trapezium, trapezoid, and os magnum, respectively, while the fourth and fifth metacarpal bones articulate with the unciform.

In pteropines the trapezium and os magnum are greatly larger than are the other bones of the second row, and give a peculiarly massive appearance to the carpus when the wing is folded. The bone first named is without nodosity on the palmar aspect. Wedged between

the two bones last named is the insignificant trapezoid. Owing to the abruptly curved line formed by the heads of the metacarpals the second and fifth bones lie at the level of the plane which would unite the ends of the curve, while the third and fourth form the bottom. The cavity defined by the curve as indicated is almost entirely occupied by a large hatchet-shape prolongation of the os magnum. Thus the os magnum, beside its axial attachments, is held on the one side to the second and on the other to the fifth metacarpal bone. The heads of these bones are so disposed as not to approach each other. The pisiform is absent unless it is represented in the palmar prolongation of the os magnum.

In rhinolophines the plan is that of pteropines. Though the bones are less massive than in that group, the methods of articulation are the same, and the pisiform is also apparently absent.

In *Artibeus* the palmar part of the os magnum articulates with a separate but much smaller element, which occupies the place of the hatchet-shape plate in *Pteropus*. The heads of the metacarpals are scarcely curved, and those of the second and fifth are disposed not to approach each other.

Among the vespertilionines we notice the following: *Corynorhinus* closely resembles *Artibeus*. In *Adelonycteris* the trapezium possesses a tubercle on the palmar aspect; the os magnum is without palmar plate, either united or separate. The heads of the second and fifth metacarpals approach each other and almost touch. In *Atalapha* the tubercle to the trapezium is retained, while the palmar extension of the os magnum is absent. Articulating on the pollical side of the fifth metacarpal bone is a separate ossicle, which appears to take the place of the part last named. It is elongated and much larger than any of the carpal elements. I have named it the pisiform. *Antrozous* is much the same as *Atalapha*; the ossicle by the side of the fifth metacarpal bone is triangular in shape. The plate of bone which is continuous with the os magnum on its palmar aspect in pteropines appears to be the same as the separate ossicle in the same situation in *Artibeus*.

The bone which articulates by its base with the fifth metacarpal bone in *Atalapha* and *Antrozous* would appear to be identical with the above plate, since when it is present the os magnum ends in a simple manner toward the palm. It would appear to be the pisiform, since in *Atalapha* it was observed to receive the tendon of the extensor carpi ulnaris.*

Sesamoid bones.—The sesamoid bones are found in locations where great motion is permitted on the side opposite to which the bones are lodged—the purpose being apparently to prevent stretching of the

*The difficulty of studying the carpus without decalcification and making sections for microscopic study is conceded. The above epitome will doubtless be modified in details when such a method of study is adopted. The pteropines and true rhinolophines are seen to be in alliance by characters derived from the carpus, a position which is in harmony with the absence of the tragus and the compact form of the otic bones.

muscles which carry the sesamoids. At the point at which stretching would begin the bones lock with the joint surface and takes the strain. They are well developed in the tendons of the extensors of the first, second and third metacarpal bones, especially in the phyllostomines.

The tendency above noted for the second and fifth metacarpal bones to incline toward one another on the palmar aspect of the carpus, and as a result for the second bone to lie in front of the third and for the fifth to lie in front of the fourth, is a notable feature in the manus of the bat. Minor differences are seen in the relative lengths of the bones. They are shortest in pteropines and rhinolophines. The second metacarpal is usually slightly shorter than the others, but in *Hipposideros* it is much shorter. The fifth metacarpal bone is apt to be the largest, as in *Pteropus*, but in *Hipposideros* and in the molossines it is the shortest. In the group last named and the related genus *Atalapha* the bones are marked by grooves for the powerful metacarpo-phalangeal flexors. The third metacarpal bone is commonly the largest, the fifth the shortest, the fourth being intermediate, yet in North American species of *Vespertilio* the fourth bone, being slightly shorter than the fifth, is sometimes an individual variation. *Megaderma* is remarkable for having the above order reversed—the fifth metacarpal is the largest and the third is the shortest. Viewed as a whole the manus, notwithstanding its enormous longitudinal development in the third, fourth, and fifth elements, is singularly unimportant in the first and second. The second, however, while unsupported by elongated phalanges, has strong architectural functions at the line of its union with the carpus.

The degrees of rigidity of the joints of the manus vary greatly. The metacarpo-phalangeal joints of the Rhinolophidae are quite rigid in all the forms examined. In most forms this joint in the fifth finger is less flexible than that of the other fingers. All things remaining the same, the degrees of rigidity are least marked in the third finger and most marked in the fourth and fifth, a proposition in harmony with the manner of dividing the manus, namely, with the aërial movement (abduction) of the first, second, and third digits away from the fourth and fifth, which in their turn are more disposed to remain stationary, and thus tend to make rigid the main portion of the wing membrane.

The forms in which the second and third digits are approximated, and the digit last named is widely separated from the fourth, embrace the Molossi, the Vespertilionidae, and the remote Pteropidae; those in which the converse appears, at least in which the second and third digits are relatively wide apart and the third digit not notably removed from the fourth, include many widely-removed groups, namely, the Phyllostomidae, the Rhinolophidae, the Epomorphi, the Plecoti, and Natalidae. It will be seen the arrangement last named prevails in the largest number of forms.

The phalanges present few points of contrast. They are uniformly

elongated rods. As a rule the second digit possesses a single rudimentary phalanx which may be free or semianchylosed to the metacarpal. The highest degree of development is attained in the pteropines and in the genus *Rhinopoma*, the former having three and the latter two phalanges. In the pteropines the third is ordinarily furnished with a claw. The phalanges vary greatly in the range of motion, those of the second and fifth digits being the least mobile; in their relative lengths in the pteropines and the genera *Noctilio* and *Miniopterus*, these forms being remarkable for the degrees present of lateral and dorsal flexion. It has been noted on p. 5 that the disposition and relative sizes of the phalanges vary in the scurrying and pendant forms. In the position of flight the row of first phalanges is flexed downward, but the row of second phalanges is at the same time deflected laterally; *i. e.*, toward the body. In the position of rest the parts either remain axially disposed or the row of the first phalanges is laterally or dorsally flexed, as in the molossines and emballonourines. The terminal cartilages are apparently absent in pteropines and rhinolophines. When present they remain in axial line with the phalanges, as in phyllostomines (excepting *Vampyrus*), or they are deflected from that line, as in vespertilionines and molossines. These little rods appear to be indices of the amount and direction of strain to which the membranes are subjected, and point, therefore, to distinctions in methods of flight. It may be said that they are absent, or, if present, axially disposed in the broad-winged forms, but are deflected in the narrow winged.* In vespertilionines (excepting *Corynorhinus*) the fifth digit is provided with an accessory cartilage, which lies to the outer side of the terminal cartilage. It slightly projects from the margin of the wing membrane.†

The usual number of phalanges to each digit is two. In Phyllostomidae the number is three to the third digit, the fourth and fifth having two each. Yet in a specimen (apparently normal) of *Phyllostoma hastatum* I note three phalanges in the fourth digit as well as the third. The third phalanx is probably a segmentation of the second rather than a distinct joint added peripherally to the series. At least it so appears

*The significance of the cartilaginous tips to the digits is not clear. At first sight they appear to be of the value of distinct phalanges, and I have until recently held to this view, but examination of sections under the microscope yields no indication of segmentation, nor does inspection of embryos show stages in which separate elements exist. Nevertheless I note in *Macrotus* excess of segmentation of the last phalanx, and Dobson observes the same in the Molossi. Interesting properties are noted in the elements of the metacarpal and phalangeal series. As a rule, they are rigid and brittle. In *Furia* these peculiarities are so marked as to make it difficult to handle a specimen without incurring a chance of breaking these exceedingly delicate structures. In the Phyllostomidae, on the other hand, they are apt to be yielding and elastic, and suggest (at least in the case of the second and third digits) that the bones are imperfectly ossified. Mr. C. Percy Moore, of the University of Pennsylvania, who has kindly investigated the subject for me, states that after attempts at decalcification the digits of bats everywhere yield tough matrices.

†Pr. Acad. of Nat. Sci.

in *Thyroptera* (an annectant genus between the American naked-nosed and leaf-nosed forms), where the length of the second and third phalanges about equals that of the second phalanx of the same digit in the allied genera *Furia* and *Natalus*.

The much greater length of the third digit, as compared with that of other digits, is a noteworthy feature of the bat wing. Its relative length in different forms serves as a guide to generic and sometimes to specific distinctions.

The peculiarities of the thumb are so marked that they can be best considered apart from the other manal parts. The thumb, as a rule, is free from membrane beyond the basal third of the first phalanx, but may be almost entirely inclosed, as in *Thyroptera*. The extent of the enwrapping membrane determines the size of the little fold of skin which lies between the thumb and the second metacarpal bone. The thumb is relatively large in pendent forms, since it is here of value in prehension; *per contra*, in *Thyroptera*, in which genus a suctorial disk takes the place of a prehensile thumb, this digit is also small, though the animal is unadapted to activity in the prone attitude. It has been already noted (p. 5) that the thumb is bent downward and the under surface of the first metacarpal bone fairly well outlined in the pendent forms. It is not known how *Desmodus* and *Diphylla*, which process with large projecting thumbs, support the body when at rest. The claws on the feet are weak, and the animals are probably not pendent at rest. With these exceptions, the phyllostomines possess the semi-flexed thumb, as do all the other families excepting the molossines and vespertiliones.

Posterior limb.—The innominate bone always exhibits a narrow rod-like ilium which occasionally projects slightly above the line of the ilio-sacral articulation, but as a rule is level therewith. The dorsum of the ilium is flat, in most forms, but it may be concave and broad, as in molossines, *Atalapha* and *Chilonycteris*. The pubis is, as a rule, defined in the males, but is absent and has a wide interval defined between the innominate bones anteriorly in the females. The shape of the ischium and of the thyroid foramen is subject to slight variation in genera and even in species. The innominate bone is in most forms distinct from the vertebral column. In molossines, *Chilonycteris*, and in rhinolophines, it is anchylosed, both at the sacro-iliac junction and the ischio-sacral or ischio-coecygeal junctions. *Chilonycteris* is an instance of the union last named. In all bats a disposition exists for the tuberosity of the ischium to approach the vertebral column, thus presenting a marked contrast to that seen in terrestrial quadrupeds. *Antrozous* exhibits a facet between the tuberosity and the first joint of the coecyx. The sloth is the only animal I can recall which exhibits a fixation of the ischium similar to that found in the bats. The ilio-pectineal spine is marked: often a large tubercle, it may be a needle-like spine. In *Hipposideros* it is of enormous length and is anchylosed to the ilium near its upper border.

The interest which attaches to the osteology of the hind extremity has led me to give in more detail the following:

In pteropines the ilium is curved outward to a slight degree at the crest. The ridge from the upper border of the acetabulum is inconspicuous and does not extend entire length of ilium; thus the ventral and dorsal surfaces are not separated and there is no special external border near the crest. The tuberosity of the ischium is deflected markedly from the line of the ilium and lies against the coccyx. The pubis is thickened inferiorly; the pectineal spine is absent or scarcely discernible.

In *Hipposideros* among the rhinolophines the *ilium* is expanded and is concave on both dorsal and ventral surfaces. The broad crest extends outward and unites by a broad thin flange to the tip of the long pectineal spine. Tuberosity of the ischium not projected backward; nearly the entire pubis and ischium converted into a broad plate of bone at the expense of the thyroid foramen. Symphysis pubis long, entire. The trochanters of the *femur* are drawn backward and approximated; the inner trochanter is the longer; the outer side of the shaft below the head furnished with a flange. The condyles small and separated by a wide notch. In the *tibia* the spine for hamstrings compressed. Internal tuberosity prolonged; no malleolus.

In phyllostomines the ilium is not deflected at crest. As seen in *Artibeus* the ridge above the acetabulum is rudimental as in pteropines—the ventral and dorsal surfaces therefore scarcely distinguished. The external border below the crest is rugose and enormously thickened. The ischium is turned but slightly toward the coccyx. The inferior border of the pubis produced inward as a long blunt process and the upper border forms a long, acicular process (pectineal eminence) which extends one-half the length of the ilium. The trochanters of the *femur* not carried back, the outer not separated from the head by a notch. The inner is much longer than the outer. The shaft at its inner side at the proximal fifth exhibits a conspicuous crest. The condyles are of equal size. Above them posteriorly is a depression (best marked over inner condyle) to receive in forced flexion the posterior border of the articular surface of the tibia. Intercondylar notch, pit-like. Proximal end of the tibia with scarcely any inward projecting process; malleolus none; tubercle for insertion of hamstrings markedly developed; surface for articulation with the fibula rugose.

In *Hemiderma* the innominate is much as in *Artibeus*, but the pubis not projecting or thickened; the pectineal spine but one-third the length of the ilium. The femur quite as in this genus, but the outer trochanter separated by a notch from the head. In *Macrotus* the innominate bone much the same as above, but the pectineal spine over one-half the length of the ilium. The trochanters of the femur approximated and carried well to the back of the shaft. The fibula only half the length of the tibia.

In *Mormops* the ilium is greatly compressed between the ventral and

dorsal surfaces; first joint of the tail very long. The femur and tibia as in *Maerotus*. *Chilonycteris* in like manner exhibits a compressed ilium ossified to sacrum with broad rugose external border adjoining crest. Dorsal surface slightly concave and expanded. In both *Mormops* and *Chilonycteris* the tuberosity of the ischium is ankylosed to the sacrum. The pubis in the male of *Mormops* is bony and entire; in *Chilonycteris* it is less firmly defined. The pectineal spine in *Mormops* is two-thirds the length of the ilium. In *Chilonycteris darvi* it is remarkable for being nearly as long as this bone and bound by fibrous tissue to the vertebræ. In both of the genera of *Lobostomidae* the trochanters of the femur are approximate, confluent, and carried well back of the head. Tibia and fibula much as in *Maerotus*.

In *Molossus* the innominate bone is compressed, expanded. It is concave dorsally with narrow iliac upper border slightly projecting. Pectineal spine one-third the height of the ilium. Pubic symphysis entire, bony. Tuberosity of the ischium projects well backward, but is free from the sacrum. The inner trochanter much larger than the outer; truncate with a downward-projecting spine, not carried backward. The outer trochanter separated from the head by a slight notch. Condyles equal in size; notch wide, shallow. Tibia straight with large malleolus.

In *Promops* the pelvis entire as in *Molossus*; characters much the same as in this genus, but the upper border of the ilium without spine and the tuberosity articulating with the sacrum, but not ankylosed thereto. Femur and tibia of the same character, the distal epiphysis of the femur narrower than the expanded shaft. In *Nyctinomus* the ilium as in *Molossus*, but the pubic bones free; femur and tibia the same.

In *Atalapha* the ilium is quite as in *Molossus*, but is not ankylosed to the sacrum. The pectineal spine is blunt, rudimental; tuberosity of the ischium lies in the same line with ilium, and approaches the sacrum, but is not articulated therewith. Both trochanters of the femur are carried backward as in *Vampyri*, but are not approximate, *i. e.*, they are visible from in front; the inner is the narrower, though they are of the same length. Condyles high and narrow, the inner scarcely the wider; notch narrow, deep. Tibia curved with medianly projecting inner tuberosity, malleolus scarcely discernible. Fibula entire; upper portion membranous. In *Antrozous* the ilium is ankylosed to the sacrum and in the male at least the symphysis pubis is well defined; the tuberosity of the ischium extends back of the line of the ilium and almost touches the sacrum. The pubic bone without a thickened inferior border. The femur and tibia much as in *Vespertilio*.

In *Vespertilio* the ilium is narrow, not expanded above, and not concave posteriorly; the outer border scarcely thickened near the crest. The pectineal spine low, compressed, directed slightly forward, blunt, scarcely higher than the acetabulum. The inferior border of the pubic bone greatly thickened near the symphysic line in the male. The in-

nominate bone is lightly held to the sacrum and at the symphysis pubis. The inner trochanter of the femur equals the external. Both are small and the gluteal crest is scarcely larger than a flange which unites the inner trochanter to the shaft, thus making the femur unique. The inner condyle is slightly the larger and the notch narrow. The tibia with large projecting median spine at the proximal end; malleolus distinct.

In *Adelonycteris* and *Lasionycteris* the parts quite as in *Vespertilio*, the pectineal spine slightly longer; the shaft of the femur just below the head less expanded.

Corynorhinus much as in *Vespertilio*, but the upper part of the femur much less expanded, the shaft near the trochanter scarcely at all.

The femur is without neck. The outer and inner trochanters are subequal and of large size, the outer tending to become the larger as in the molossines. The outer side of the shaft below the trochanter is often marked by a flange in position of the third trochanter. *Hipposideros* and all phyllostomines show an inclination to the development of a conspicuous flange on the inner side of the shaft near the inner trochanter. This is most marked in *Chilonycteris*, *Mormops*, and *Natalus*. In the genera last named the trochanters are drawn backward, lie on the posterior surface of the bone, and are in close relation (resembling, with the head, the anterior end of a geometric larva), while as a rule they are on lines which answer to the lateral ligaments of the knee joint. The condyles are approximate markedly unequal with a narrow intercondylar notch, the inner condyle being the larger, as is the rule, or wide apart with small condyles, as in molossines and rhinolophines. The tibia may be shorter than the femur, as in *Artibeus* and *Molossus*, but it is, as a rule, longer than that bone. The inner tuberosity is furnished with a horizontally-projecting process in vespertilionines; this is an excellent character defining the family. The tubercle for insertion of the hamstrings is most marked in strictly arboreal forms, as the pteropines. The malleolus is often rudimentary or absent, as in phyllostomines and rhinolophines. The fibula is uniformly imperfect above save in the molossines, where it is complete, or in *Antrozous*, where a membranous fillet continues the form of the bone to the inner tuberosity of the tibia.*

*Since the above sketch was written the skeleton of *Desmodus* has been examined. I find that it bears a close resemblance to other phyllostomines, but is distinctive in the following particulars: The shaft of the radius is joined at its middle by the ulna, which can be traced, nevertheless, apparently to the wrist. I say "apparently" for the femur, tibia, and fibula exhibit dispositions to form lateral flanges, and it may be that the structure in *Desmodus* is not the reappearance of the lost ulna-shaft but is simply the radius, which here exhibits an unusual form. In any event it constitutes a character not seen elsewhere in the order. The flanges of the femur are symmetrical, directed forward, and convert the anterior surface of the shaft into a groove for the origin of the femoral head of the quadriceps extensor muscle. The flange in the tibia and fibula is single; the two are in contact—to obliterate the interosseous space.

The toes retain two phalanges to the first toe; all the others have three, but differ in their relative lengths. The first phalanx of the first toe is, so far as examined, longer than that of the other toes. In *Pteropus* the lengths of the toes from the second to the fifth gradually diminish. In *Chilonycteris* they abruptly increase, that of the second toe being one-third shorter than the fifth. In all bats the tarsus and calcaneum are elongate and exhibit the general character of these bones in mammals, in which little or no weight is borne upon the posterior extremities. Both bones are so disposed that the larger end of each is directed proximally. In *Rhinolophus* the calcaneum enters into the ankle joint. In other forms the calcaneum is independent of the joint. In Phyllostomidae, including *Natalus*, as well as in the genus *Rhycho-nycteris*, the calcar* is placed in axial line with the calcaneum. In other families it joins the calcaneum to its outer side at a well-defined angle. As a rule the astragalus and calcaneum are nearly of one size, but in the genus last named the calcaneum is notably the smaller (Am. Naturalist, Feb., 1886, 176).

GENERAL PLAN OF ANTERIOR EXTREMITIES IN FLYING VERTEBRATED ANIMALS.

From the above consideration it will be seen that the wing membranes possess various features which can be used in distinguishing the members of the order. But after what manner are the flying mammals distinguished from other flying vertebrates?

There are two distinct types of modification which the vertebrate skeleton has undergone in adapting the animal for flight, both of which depend upon some peculiarity in the structure of the anterior extremities; and in order to obtain a correct opinion of them we propose to cast a glance at each in turn.

A plan of bony structure of the wings of flying vertebrate animals.

a. Bones of carpus ununited, distinct; flight maintained by dermal expanse.	{	I. Wing membrane supported by all fingers. <i>Bats</i> (<i>Vespertilio</i>), order of MAMMALIA.
		II. Wing membrane supported by the fourth finger only (which is immensely developed), the others remaining free. <i>Pterodactyles</i> , order of REPTILIA.
b. Bones of carpus united; flight maintained by dermal appendages.	{	III. Bones of metacarpus, two to three in number; feathers not radiating. <i>Living birds</i> (AVES)—class.
		IV. Bones of metacarpus, four in number; feathers radiating. <i>Archaeopteryx</i> (AVES)—subclass.

*The calcar is an element of doubtful homology. It supports the free border of the intertarsal membrane and is of the same significance as the accessory cartilage of the fifth manual digit.

- I. The Bat, in which the humerus is long and slender, with a small pectoral ridge. Ulna rudimentary. The radius constitutes the bulk of the forearm; carpus composed of six bones; the metacarpal bones, five in number, separate and distinct; the phalanges generally, two in number; thumb, and in some genera the index finger, surmounted by a claw.
- a. II. The Pterodactyl, in which the humerus is short and straight, very broad at head, with angular and prominent pectoral ridge; ulna and radius distinct, of nearly equal size; carpus composed of five bones; metacarpus of four bones, separate and distinct; first finger with three joints, second with four, third with five, fourth with four joints, all provided with claws, with the exception of the fourth, which is remarkable for the extraordinary development of its several joints. It is from this last-mentioned finger to the base of the foot that the skin was stretched by which the animal was enabled to fly.

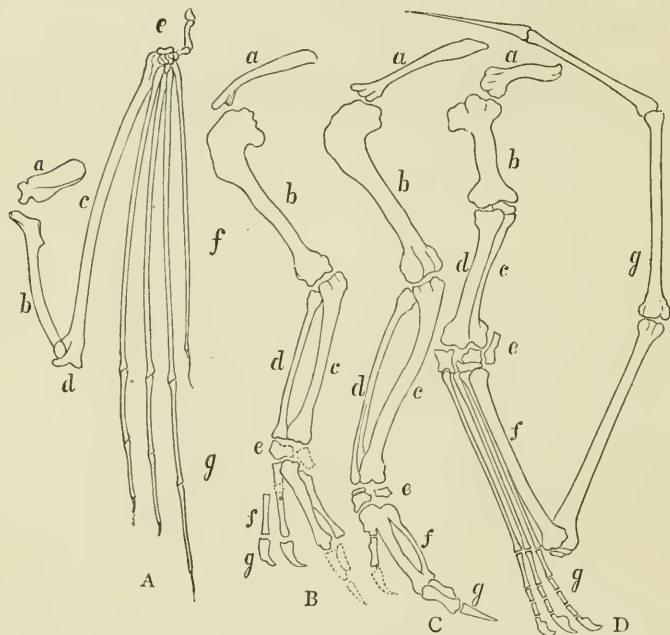


DIAGRAM OF THE BONES OF ANTERIOR EXTREMITIES OF FLYING VERTEBRATES.

- A. BAT.—*a*. Scapula. *b*. Humerus. *c*. Radius. *d*. Rudiment of ulna ankylosed to radius. *e*. Carpus. *f*. Metacarpus. *g*. Phalanges.
- B. ARCHÆOPTERYX.—References as in Fig. 1. The dotted outlines seen at carpus and the terminal phalanges are restored portions.
- C. BIRD.—References as in Fig. 1. The dotted outline of the second ungual phalanx indicates the occasional occurrence of a claw at this point. The majority of birds are without it.
- D. PTERODACTYLE.—References the same as in Fig. 1

- III. The Bird, in which the humerus is curved, more or less slender; pectoral ridge prominent, not angular; ulna large, curved, not united with the slender and more diminutive radius; carpus or two bones; metacarpus of two, sometimes of three bones, the first being small and cylindrical, the other two of larger dimensions and united so as to form a bone resembling those of the forearm; ulnar phalanx of one joint, united to the radial, which is composed of two.
- b. The power of sustaining flight not dependent upon the expansion of skin, but upon the excessive development of dermal appendages (feathers).
- IV. The Archaeopteryx agrees with the typical bird in general particulars, but differs in the number of metacarpal bones, which are here four in number: the first and second are slender, free and separate from one another; the third and fourth bear considerable resemblance to those of extant birds, in being large, stout, and closely approximated; but are not, however, united. Flight is supposed to have been maintained in the same manner as in living birds.

In addition to the instances already given, certain fishes, as the *Exocoetus* and *Dactylopterus*, possess the power of sustaining true flight. The mechanism that lifts the body of the fish from the water, and upholds it for a short time in the air, is obtained in the pectoral fins, which, in these animals, are enormously developed. The structure of these fins is homologous to that of the anterior extremities of other vertebrates, their form alone being modified to adapt the animal to the medium in which it is placed. Thus we have, in each great subdivision of vertebrate animals, a representative capable of sustaining flight.

Another somewhat similar modification of the animal economy is met with in a few animals of arboreal habits. Here a peculiar arrangement of the skin is observed, which enables the possessor to break the force of downward leaps. In the Flying Lemur (*Galeopithecus*), in the Flying Squirrel (*Pteromys*), and in the Flying Opossum (*Petaurista*), the furred skin extends laterally from the sides of the body and is attached to anterior and posterior extremities at the metacarpal and metatarsal regions respectively. The only instance of osteological development is obtained in the Dragon (*Draco volans*), a small lizard from Sumatra, in which long, transverse processes from either side of the lumbar vertebræ support a thin membranous growth which is capable of being opened and shut by means of museles attached to the bony frame-work.

TEETH.

In describing the molars the nomenclature of H. F. Osborn will be followed. The diagram herewith presented is copied from this writer's paper in the American Naturalist, December, 1888, p. 1072.

UPPER MOLARS.

Antero-internal cusp	Protocone.	pr.
Postero-internal cusp or sixth cusp.....	Hypocone.	hy.
Antero-external cusp	Paracone.	pa.
Postero-external cusp	Metacone.	me.
Anterior intermediate cusp.....	Protoconule.	pl.
Posterior intermediate cusp	Metaconule.	ml.

LOWER MOLARS.

Antero-external cusp.....	Protoconid. pr ^d
Postero-external cusp	Hypoconid. hy ^d
Antero-internal cusp or fifth cusp	Paraconid. pa ^d
Intermediate or antero-internal cusp (in quadritubercular molars) ..	Metaconid. me ^d
Postero-internal cusp.....	Entoconid. en ^d

The upper molar in most bats presents to an extraordinary degree depressions on the outer or buccal surface of the crown. Such depressions receive the name of "flutings" and are seen in the teeth of many mammals other than the bats, as for example in the moles and shrews among the Insectivora, in the Ungulata, and in a marked degree in an extinct genus described by E. D. Cope, *Lambdotherium*. "Flutings," while of no homological significance, furnish systematic characters, and will therefore be noted in the descriptions. Disposed so as to define two V-shaped figures the "flutings" extend as a sinuate commissure between the paracone and the metacone. Of the two Vs an anterior and a posterior will be distinguished. Each V has two limbs, a first and a second. In the third molar various degrees of loss of the system of flutings occur. Commonly the anterior V is retained while the second is lost, excepting the buccal half of the first limb, as in *A. fuscus*, or the "fluting" is reduced to the anterior V, the palatal half of the second limb being lost, as in *Macrotus* and *Atalapha*. In the bats of North America the least reduced last molars are seen in *Nyctinomus* and *V. hesperus*.

The tritubercular tooth which results from the presence of the three cusps, the protocone, the paracone, and the metacone, may be connected with a triangular figure by bands which unite the cusp-points. These bands will be named in this monograph the *commissures*. In the molars of the bat such a triangle is seen whose apex is palatal and constituted of the protocone and whose commissure extends from this cusp to the paracone and metacone. Its base is the extraordinarily sinuate ("fluted") buccal surface of the crown. A careful search must be made for the true positions of the sides of this triangular figure, for they lie on the opposed sides of the teeth and are inconspicuous. The crown at the "flutings" is of great vertical extent and dwarfs even the proportions of the protocone. When seen in profile the proportions between the size of the "column" of the two Vs and the "cusp" of the protocone afford materials for interesting comparisons in the different genera. The hypocone presents excellent subordinate characters. It is a development of the cingulum. Usually flat, as in *Macrotus*, it may be sharply defined as in *Promops perotis* or provided with a sharp cusp as in the exotic genus *Noctilio*. The cingulum can be traced as a delicate ridge which lies basal to the sides of the tritubercular triangle. It varies greatly in extent, being best developed in *Nyctinomus*.

In the lower molar scarcely any fluting is present and the plan of the tooth is simple. The protoconid, paraconid, and metaconid are united by commissures. The apex of the triangular figure is buccal. The

heel or hypoconid is large. It is united to the triangle by a commissure at the lingual side. Such a commissure is provided with a sharp cusp in *P. perotis*, but as a rule it is smooth.

The student can not fail to be impressed with the variable form of the lateral incisor in both jaws. In the lower jaw it may be of the same character as the other teeth in its series, as in *Adelonycteris*, *Vesperugo*, and *Lasionycteris*. It may be more robust than its fellows, as in *Vespertilio*, but oftener is simpler in outline, as in *Corynorhinus*, and may be not only so, but dwarfed in all proportions, as in *Nyctinomus brasiliensis*. The next step may be anticipated, namely, its entire disappearance, as in *Nyctinomus macrotis* and in *Promops*.

These modifications suggest that the tooth has a struggle to maintain its own in the dental armature. At all events its study is one of interest, and should never be omitted in defining the characteristics of all forms whatever, either of variations, species, or genera.

The first and second premolars in both the upper and the lower jaw, and the third incisor in the lower jaw, often present a perfect cingulum. This is distinctly seen in the first premolar of *Atalapha*. Such a tooth is remarkable since, as far as I know, it is without parallel elsewhere in mammalian teeth. Various degrees of development of the buccal aspect of the cingulum appear to give rise to a cusp, which then arises *after* the outer or buccal cusp. I was led, in an early study of the human dentition, to claim that this the outer (labial) cusp of a bicuspidate form arose first and the inner (buccal) cusp arose later. I have long maintained (*Dental Cosmos* Phila. 1874, 617, also *Studies in the Facial Region*, 1874) the primitive tooth to have been monocuspidate and the subsequent forms to have been developments therefrom. But my claim has not been allowed.

An excellent view for contrasting taxonomic characters is that obtained by examining with a lens the lingual aspect of the lower molars. On the whole, the first molar yields the most trenchant characters. Three cusps are seen in profile, named, from before backward, the paraconid, metaconid, and hypoconid. The proportions of these to one another should be made in all studies of the teeth. In pteropines the three cusps are merged, and a simple convex contour results. A similar effect is produced in *Hemiderma* and *Brachyphylla* among the phyllostomines. For the most part the three cusps are separately displayed as acute triangles, whose bases are confluent. In rhinolophines the hypoconid is flat, produced backward, as is also the case in *Choeronycteris* and *Phyllonycteris* among the glossophagines, but in other genera it is acutely cusped and co-equal with the two preceding elements. In *Natalus* it is actually the largest of the series.

KEY TO GENERA.

- I. Bats with median appendage to nose, four incisors in lower jaw... *PHYLLOSTOMIDÆ*.
- a. Body massive, auricle shorter than head, not united with its fellow... *Artibeus*.
- a'. Body slender, auricle as large or longer than head, united with its fellow
..... *Macrotus*.
- II. Bats without median appendages to nose.
- b. Nostrils circular, wings narrow and pointed; tail long, produced far beyond
interfemoral membrane; marginal toes fringed with coarse hair. *MOLLOSSI*.
Lips grooved..... *Nyctinomus*.
Lips not grooved..... *Promops*.
- b'. Nostrils elliptical, wings broad, ample; tail as long as, or slightly longer
than, the broad interfemoral membrane; marginal toes naked.....
..... *VESPERTILIONIDÆ*.
- c. Two incisors in upper jaw.
- † Six incisors in lower jaw.
- * Interfemoral membrane more or less hairy.
- Premolars $\frac{1}{2}$ *Dasypterus*.
- Premolars $\frac{2}{2}$ *Atalapha*.
- ** Interfemoral membrane not hairy *Nycticejus*.
- †† Four incisors in lower jaw..... *Antrozous*.
- c'. Four incisors in upper jaw.
- † Premolars $\frac{1}{2}$; greatest width of tragus at base equals one-half of inner
border..... *Adelonycteris*.
- †† Premolars $\frac{2}{2}$.
- * Greatest width of tragus equals much less than one-half inner border;
nose simple, ears separate..... *Vesperugo*.
- ** Greatest width of tragus equals one-third height of inner border;
auricles united.
- § Nose with lateral club-shaped gland-masses..... *Corynorhinus*.
- § § Nose without lateral club-shaped gland-masses..... *Eudernia*.
- ††† Premolars $\frac{2}{3}$; greatest width of tragus at middle and equals two-thirds
height of inner border *Lasionycteris*.
- †††† Premolars $\frac{3}{3}$. Lips whiskered, dorsum of face furred..... *Vespertilio*.

Family PHYLLOSTOMIDÆ.*

Genus **MACROTUS** Gray.*

Macrotus Gray, Proc. Zool. Soc. London, 1843, 21.

Otopterus Flower and Lydekker, Mammals Living and Extinct, 1891, 673.

Diagnosis.—Ears large, united, produced inferiorly far beneath the small external basal ridge; nosed-leaf simple, abruptly acuminate, complete, no separation between the basal and ascending parts; the median ridge confined to the interval between the nostrils. Tragus tapering, convex on inner border and straight on the outer. Wing membrane reaching to ankle; tail long, extending a short distance beyond the ample interfemoral membrane. Lower lip and mentum deeply cleft.

Dental formula.—Molars $\frac{3}{3}$; Premolars $\frac{2}{3}$; Canines $\frac{1}{1}$; Incisors $\frac{2}{2}$, $\times 2 = 34$.

J. E. Gray (Voy. of *Sulphur*, p. 28). places *Macrotus* in a separate division from the American leaf-nosed bats and of equal rank with the groups now understood as the *Stenodermata* and *Vampyri*. The following genera are considered by him to be closely related and are thus defined: Tail short, with point on the upper side of the wide inter-

* PHYLLOSTOMIDÆ.—Bats with laminate ectoturbinals of the ethmoid bone; premaxillæ with palatal processes forming a median suture and defining an incisive foramen; trapezium without palmar tubercle, thus permitting flexion of the thumb; wings adapted for a fanning flight, (excepting possibly *noctilio*) but not for terrestrial progression; ulna with shaft ankylosed to the radius at the proximal third; proximal rudiment nonperforate; fifth digit without accessory cartilage; coracoid process not bifid, curved forward; no raised folds of skin at the junction of carpus and metacarpus to represent the palmar fascia; no oblique line on the wing-membrane at the lower third of the tibia; nose-leaf dominant, but absent in aberrant forms contained in *Lobostomi*, *Noctilionini*, *Natalini*, *Thyropterini*.

Mr. F. W. True has kindly furnished the following note:

Flower and Lydekker, in their recently published work—*Mammals, Living and Extinct*—substitute the name *Otopterus* for this genus, on the ground that *Macrotus*, Gray, is preoccupied by *Macrotis*, Dejean. It appears, however, that Dejean's name, which was published in his *Catalogue des Coléoptères*, 1833, p. 186, was not accompanied by a diagnosis, and has not been adopted by later writers on insects. It can not, therefore, be regarded as valid.

Quite aside from this fact, it is questionable whether *Macrotus* and *Macrotis* should be regarded technically as identical names. Agassiz gives “μακροτης=longitudo” as the proper derivation of the latter (as also of his genus *Macrota*). This is interesting, as Reid in 1836 (P. Z. S., p. 131) gave the name *Macrotis* to *Paramelops lagotis* (now called *Peragale lagotis*). If the difference in the termination of the two words is to be disregarded, Gray's name is preoccupied by that of Reid. This, as already stated, seems open to question, and Gray's name is, therefore, retained.

femoral membrane; ears lateral, separate. *Mosia*, *Mystacina*, *Aello*, *Emballonura*, *Centronycteris*, *Urocryptus*, *Diclidurus*, *Taphozous*, *Nocilio*, *Phyllodia*, *Chilonycteris*, and *Mormops* are embraced in this oddly-arranged group. In the same work, p. 16, the author places *Macrotus* near *Megaderma* and *Rhinopoma* as a subgroup of the Phyllostomina: "Ears close together over the forehead; forehead with a rather deep pit; nose-leaf lanceolate, erect; tail elongate, produced beyond the interfemoral membrane; wings from the ankle; lower joint of thumb moderate."

Wagner was of the opinion last named, that *Macrotus* exhibits affinities with *Megaderma*. S. F. Baird followed this writer, and I naturally accepted this opinion,* since my work was carried on under the guidance of the eminent authority last named. Peters, in his revision of the Phyllostomidae,† definitely fixed the position of the genus.

Macrotus resembles *Lonchorhina* in the elevation of the nasal bones and in the depression on the facial portion of the frontal bone, as well as in the elevation of the skull at the vertex near the occiput and in the large size of the tympanic bone. From *Lophostoma* it is easily distinguished by the absence of the temporal crest, which is so conspicuous in this genus, and by the form of the zygoma, which is high and of uniform diameter throughout. The frontal bone is without a depression in the facial portion, and the nasal bones do not form a ridge, while the dorsi-facial surface is cylindroid. *Phyllostoma* is distinguished in having a small lachrymal process and a flat, broad, dorsi-facial surface. The temporal crest is defined, though not conspicuous. The zygoma is of the same character as in *Macrotus*. The tympanic bone is much smaller than in this genus. In a fragment of an immature skull of *Vampyrus auritus* the skull is without temporal crest, the dorsi-facial surface is cylindroid and without depression on the frontal bone.

1. *Macrotus californicus* Baird. (Plates 1, 11.)

Macrotus californicus Baird, Proc. Acad. Nat. Sci. Phila., 1858, 117. *Ib.*, Rep. U.

S. and Mexican Boundary Survey, pt. 2 (Mammals), 1859, 1, Pl. 1, Fig. 2.

Macrotus waterhousii (in part), Dobson, Cat. Chirop. Brit. Mus., 1878; Alston, Biol. Centrali-Amer., Mam., 1879-'82, 38.

Diagnosis.—Auricle much longer than head. Basal lobes well developed. Nose-leaf with defined lower border. Fur (above and below) base, white; terminal third, fawn; tip, gray.

Description.—The auricle is ovate and longer than the head. The internal basal lobe is rounded and free, raised above the head and resting against the interauricular membrane. The external basal lobe is large, the greatest width equal to the distance between the eye and end of the muzzle. A prominent wart, which lies above the rictus,‡ terminates the lobe anteriorly. Two longitudinal ridges are seen on the inner

* Monograph N. A. Bats, 1864.

†MB. Akad. Berlin, 1865, p. 256.

‡Rictus will be used as a term interchangeable with *angle of the mouth*.



EXPLANATION OF PLATE I.

FIG. 1. Front view of head of *Macrotus californicus*.

FIG. 2. Side view of same.

FIG. 3. View of tragus and inner surface of auricle.

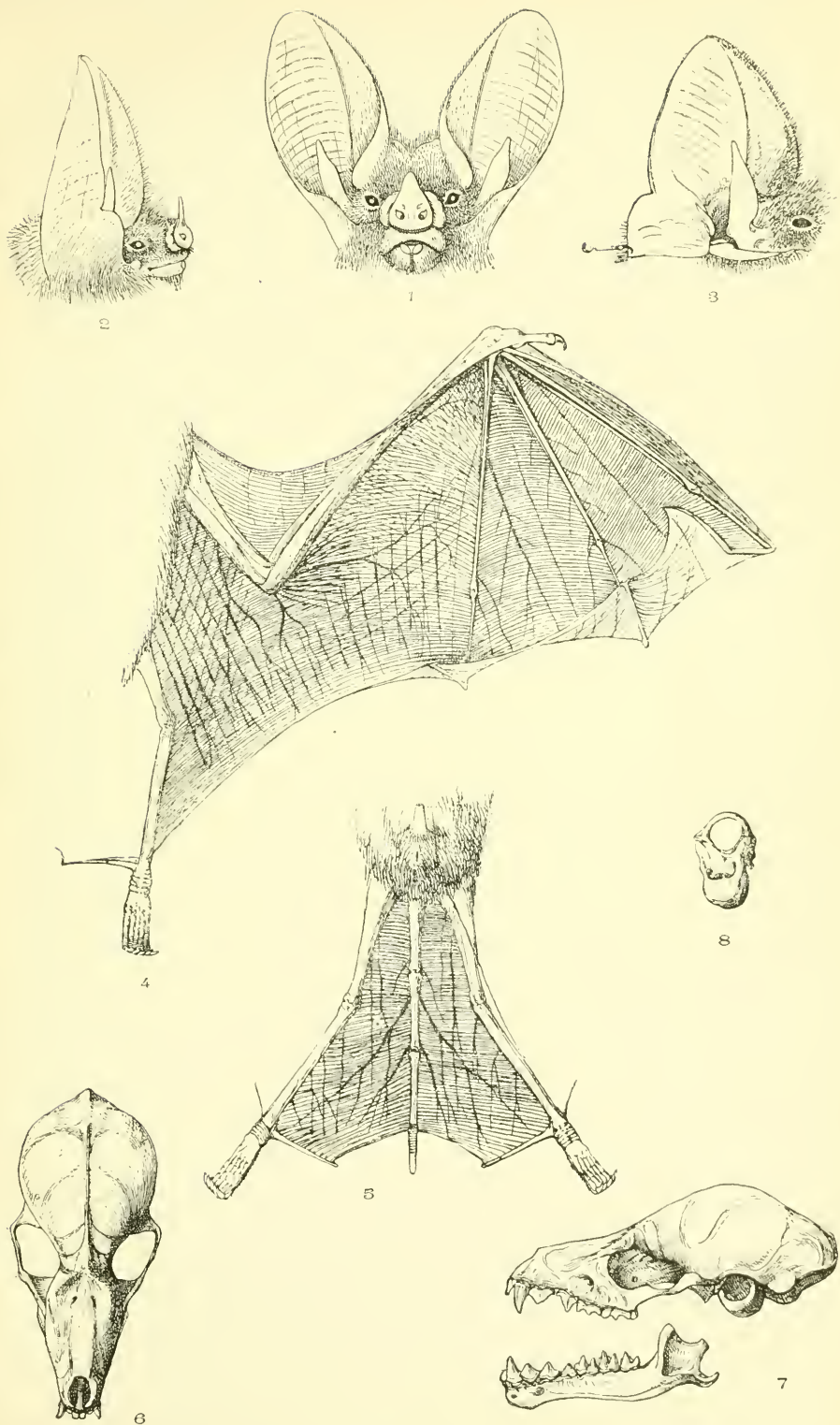
FIG. 4. The wing membrane of same.

FIG. 5. The tail and interfemoral membrane.

FIG. 6. The skull seen from above. $\times 2$.

FIG. 7. The skull and lower jaw seen from the side. $\times 2$.

FIG. 8. The os petrosa. $\times 2$.



MACROTUS CALIFORNICUS.

surface, one small and inconspicuous at junction of internal basal lobe to the main portion of the auricle; a second, much longer, arises behind the tragus and passes upward nearly to the tip. The auricle anterior to the ridge last named is sparsely covered with hair. Numerous delicate transverse folds are seen on the outer half of the auricle, which reach almost to the border. Nearly on a line with the junction of the external basal lobe and the main portion and opposite to the meatus a semilunar raised fold is seen.

The interauricular membrane is notched above, hairy on the outer surface, and with a longitudinal ridge in young individuals in the middle line. The membrane extends beyond the inner canthus of the eye, at which point it bears a small wart. The tragus is long, slender, and tapering; when laid forward it reaches to the inner canthus. The posterior surface is furnished with a longitudinal ridge. The base exhibits two roots, one extending a short distance obliquely on the face; the other continuous with the ridge opposite to the meatus. The tragus is slightly constricted above the facial root, but soon becomes convex along the inner border. The outer border is straight, excepting at the base. Here the parts are variable. In the greater number of specimens examined a trace only of an external basal lobe is seen.* The nose-leaf is simple, entire, rounded at the muzzle and fixed to the upper lip, while free at the sides. The erect portion tapers acutely, and is sparsely covered with hair. A rudiment of a midrib is seen between the nostrils. The nostrils are oblong, oblique, with raised trenchant borders. They are slightly narrowed externally and do not modify the lateral contour of the nose-leaf. A crescentic patch of warts lies on the face back of the muzzle. Two small, slightly oblique, smooth mental plates, separated by a groove, are seen at the chin. Well back of the chin-plates is a conspicuous median wart. The rictus is on a line with the inner canthus. The wing membranes are attached to the epitrochlea.† The fifth metacarpal bone is the longest.

The prevailing color of the fur is white. On the dorsum for the apical fifth it is light brown, fawn, or yellow brown. Frequently the extreme tip is gray. On the venter the basal half of the hair is alone white, the apical half being ashy-brown, the extreme tip again appearing white or plumbeous. The face retains the color of the venter without the basal white. The side of the neck and the base of the prebrach-

* In a young individual (8916, S. I., the epiphyses not united, and the length of the body 41^{mm}) the external basal lobe was thick and acutely concave on the outer border. It was obscurely verrucose and received by a delicate fold the outer border of the tragus upon its anterior surface. A thickened longitudinal swelling was seen on the posterior surface near the inner border. In a second immature specimen (42^{mm} long, the milk teeth being in position) the tragus was more as in adult.

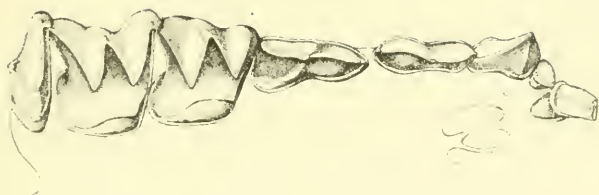
† In an immature specimen, No. 4405, Mus. Comp. Zool., the membrane came from the epicondyle.

ium are of the colors of the dorsum rather than the venter.* Immediately behind the junction of the ears the head is almost naked. The basal third of the auricle is covered with hair. The external surface of the external basal lobe is entirely clothed. The inner surface of the auricle at the internal basal lobe, and extending thence upward along the inner border, is sparsely covered with short hairs. The proximal half of the humerus is also clothed, as well as the endopatagium, and a line thence to the proximal one-half of the thigh. Elsewhere the membranes are naked, save at the dorsum of the first metacarpal bone, where a few hairs are found.

Membranes.—In the second interspace of the wing the membrane is attached to the palmar borders of the second and third metacarpal bones; in the third interspace, to dorsal border of the third metacarpal bone and palmar border of the fourth; and in the fourth interspace, to the palmar borders of the fourth and fifth metacarpal bones. The calcaro-tarsal expanse is absent. The prebrachium is without distinctive lines. Intercostal lines nine in number. Coraco brachialis fascicle does not reach the line of the elbow. At the elbow is a number of fine, radiated lines, apparently due to muscle-fibers. The membrane is slightly thickened near the ankle. Triceps fascicle system made up of two inferior and two superior branches. Vertical muscle lines seven in number. A small thread-like line appears at the proximal third of the fifth metacarpal and passes nearly the entire length of the digit. In the fourth interspace the predigital nerve arises from the fifth metacarpal bone at about its middle; one or two nerves arise from the fifth metacarpophalangeal joint; the post-digital from the metacarpophalangeal joint; longitudinal line distinct. Thirty-six transverse lines can be counted in the fourth interdigital interspace. These are greatly in excess of the number in any other form examined. Both in this space and in the angle between the fifth metacarpal bone and the radius a fine network of fibers is present. No similar appearance is seen elsewhere. In the third interspace both predigital and post-digital nerves arise from the metacarpophalangeal joints; longitudinal line distinct.

The interfemoral membrane reaches to the ankle. The tail projects one-sixth of its length beyond the inferior margin. An oblique line extends from the end of the second vertebra to the middle of the calcar. The structure last named is one-half the length of the tibia; its tip projects conspicuously from the truncated border of the interfemoral membrane. The terminal cartilage of the third digit acicular; that of the fourth digit is bifid, with the lobes equal; while that of the fifth digit, while bifid, exhibits the posterior lobe greatly prolonged. In specimen No. 404 S. I. the terminal cartilage of the right third digit is composed of four segments.

*Cones and Yarrow (Wheeler Exp. Geol. Surv., Zööl, 1875) state that alcohol-bleaching causes the difference between *M. californicus* and *M. waterhousii*. Of this statement the authors offer no evidence. I doubt its correctness.



1



2

1. MAXILLARY TEETH OF *MACROTUS CALIFORNICUS*. X 8.
2. MANDIBULAR TEETH OF SAME. X 8.



Variations.—The distance between the tail and the tip of the calcar is inconstant. The sides of the interfemoral membrane do not always end at precisely the same level on the tail.

The basal part of the nose-leaf may be separated from the ascending part by a sulcus in the manner seen in *Artibeus* and *Phyllostoma*. The lower margin may be separated from the groove to the outer side of the lateral margin.

Manal formula.

	Adult 50mm long.	Immature 44mm long.
Second interspace	3	2
Third interspace	20	13
Fourth interspace	25	18
Forearm	27	44

Skull.—The brain case is raised much above the level of the face. The sagittal crest is defined, except on the metencephalon, where, excepting at the extreme tip of the angle between the vertex and the occiput, it is absent. No convexity exists over the region of the proencephalon, which measures one-eighth of the length of the brain case. The region of the metencephalon measures one-third of the length of the brain case. The tympanic bone is large, almost entirely concealing the cochlea. The basi-occipital bone is without lateral fossae. The lingual process of the sphenoid bone is rudimentary or absent. The posterior temporal impression is deflected from the sagittal line at metencephalon to define with the aid of the fellow of the opposite side a large, triangular, convex space. The face vertex is markedly inflated at the side for the greater part of its length; a median ridge extends over the anterior two-thirds, the posterior thirds being depressed; on each side of the median line a small foramen, which transmits a nerve to the auricle, is seen. On the side the inflation occupies the greater part of the superior maxilla and causes the region of the infraorbital foramen to be slightly depressed. The anterior border of the orbit is trenchant. The ectoturbinal plates show through the frontal bone as it forms the orbital inner wall; a small foramen is seen near the rhinencephalon lying below an oblique ridge. The upper border of the malar bone is incised at the middle third. A line produced from the upper border of the anterior nasal aperture intersects the middle of the first upper premolar. The inner surface of the ascending ramus of the lower jaw is furnished with a ridge which extends forward on a line with the teeth. The condyle end reaches the alveolus. The angle is narrowed, curved, and tapering at the tip; it projects posteriorly beyond the condyle to the outer third of which it lies as the bone is viewed from above. The distance from the condyle to the tip of the coronoid is equal to the width of the horizontal ramus.

The cochlea in the Phyllostomidae, as a rule, exhibits the loop of the

outer semicircular canal free from bone. In *Macrotus* this character is less constant than in other genera examined, for out of three examples one showed the loop occupied with a thin, bony lamina.

	Millimeters.
Length of skull.....	23
Width of skull at the widest part	9
Width of dorsi-facial region at the widest part.....	5
Length of superior dental series	9
Width of base at the glenoid cavities.....	11

In the skull of an immature individual from the Museum of Comparative Zoölogy, measuring 21^{mm} from end of the premaxilla to the occiput, the following characters are noted: The mandible projects 2^{mm} beyond the premaxillæ. The premaxillæ do not join the nasals, which are twice as wide at the posterior ends than at the anterior. The tympanic bones are complete.

The arrangement of the turbinal plates is as follows: The ectoturbinal is small, a little less than one-half the length of the first endoturbinal. Its upper border is horizontal and its lower concave. The extreme tip of the lobule extends as far as the anterior border of the first molar. The second plate is concealed and the third and fourth are arranged much as in *Vampyrops*, which this form in great part resembles. The lobule on the first endoturbinal is small, but readily discernible. The plates below their inflated summits are not clearly seen. The parts on the median surface are contiguous.

Notes on the skeleton.—The atlas is provided with two spines on the inferior border of the transverse process and a tubercle on the body. The meso-sternum is provided with a trenchant unbroken keel. The ulnar rudiment at the distal end of the radius is a minute tubercle without notch or foramen; the proximal rudiment is a little less than half the length of the radius. The vertebral border of the scapula is sigmoid with the concavity corresponding to the base of the spine. The infra spinatus fossa is not deepened at the axillary border. The end of the spine at the glenoid cavity end is not angulated. The coracoid process is abruptly curved toward the axillary border; the end reaches a point below the glenoid cavity. The inner tuberosity of the humerus is scarcely elevated above the level of the head. A narrow notch is defined between the epitrochlea and the trochlea, the under border of the epitrochlea is furnished with a spine.

The first metacarpal bone equals one-half the length of the first phalanx of the first digit, the second lacks one-fifth the length of the third metacarpal bone and is slightly arched. The second digit is as long as the third metacarpal bone. The third and fifth metacarpal bones are of equal length and are not as long as the forearm. The fourth is 2^{mm}. shorter. The third metacarpal bone is much the stoutest, the second phalanx is slightly the longer. In repose the first phalanx of the third digit is in axial line with the third metacarpal bone. The fourth and fifth digits are of the same length. The femurs

brought nearly to the median line posteriorly, where they lie almost in contact.*

Maxillary teeth.—Central incisor much larger than the lateral, contiguous with its fellow with sharp transverse cutting edge. The lateral incisor very small, crown directed obliquely forward and inward with an obscurely bilobed cutting edge. Canine rather small not twice the length of the central incisor; the first premolar as broad as the second but less abruptly pointed and touching canine. The second premolar with wide base where it rests against the first molar. An interval exists between the two teeth. The first molar slightly inclined backward with low protocone and obscure commissures, the posterior being in great part absent. Paracone forming a smaller V than the metacone but is more fluted than it. Hypocone obscure, low. The second molar more quadrate than the first; the protocone somewhat better defined. The Vs of the buccal cusps equal but the protocone is tumid at an angle formed by it with the anterior border of the crown. The third molar with protocone having well defined commissures. The posterior limb of the paracone but half the length of the anterior limb. The remaining parts of the tooth not represented.

Mandibular teeth.—Incisors simple, even, obscurely bilobed. First premolar higher and broader (in profile) than the second and third. This distinction is not so apparent when the parts are viewed from above. The second and third premolars are progressively more pointed and lower than is the foregoing.

The first molar with the V much smaller than the triangular heel whose anterior limb juts against the posterior limb of the V near its base (perhaps, on the whole, to a less degree than is represented in the figure). The base (*i. e.*, the lingual aspect) of the V is open, but that of the heel is closed by a depressed commissure. The second molar much the same as the foregoing, the V and heel being subequal. The third molar with the largest V in the series but with a small, compressed, deflected tubercle like heel.

Paraconid in first lower molar smallest of any in the series. The conjoined bases of the paraconid and metaconid deeply incised so as to show the protoconid when the tooth is seen in profile on lingual aspect. This character is not seen outside of this group, but reaches a higher degree of development in *Ischnoglossa*.

List of specimens.

Cat. No.	Specimens.	Locality.	Sex.	Presented by—	Nature of specimens.	Collection.
2347	1	Fort Yuma, Cal	.....	Maj. G. H. Thomas...	Alcohol (type)....	U.S.Nat.Mus.
5214	28	Cape St. Lucas	.....	John Xantus	Alcohol.....	Do.
6174	1	do	.....	do	do	Do.
11205	5	do	♀, 1 ♂	.....	do	Do.
8916	1	Near Tucson	♂ imm.	.....	do	Do.
6171	.....	No locality	♀	.....	do	Do.

* For other comments on the skeleton of *Macrotus*, see Introduction.

Dobson (*l. c.*) considers *M. californicus*, Baird, to be the same as *M. waterhousii*, Gray. Specimens of the latter are not available for examination. Bats of the Antilles may range north and west through the neotropical belts of the United States, but *M. waterhousii* does not appear to be an example of the tendency. By the measurements taken by Mr. Dobson this species appears to possess a smaller tail and a shorter appendage to the nose than does *M. californicus*. Among other measurements (English scale) of West Indian species are the following: head, 1^m; body, 2.60^m; tail, 1.50^m; ear, 1.10^m; tragus, 0.42^m; nose-leaf, 0.30^m; wing from carpus, 0.3^m; forearm, 0.2^m.

On the whole, I have concluded not to make any change in the name of the Californian species of *Macrotus*, and shall rest content to quote from the first edition of the Monograph (pp 3, 4) the following passages:

A comparison of the type with good specimens of the latter from Cuba, preserved in alcohol, and presented by Prof. Poey to the Smithsonian Institution, show unmistakable differences, as do others from Jamaica, recently received from Mr. March.

The chin plates are less acutely defined; the internal border of the tragus is much thickened, and the revoluted portion at the base of the external border is slightly swollen. The fur is bicolored; central portion dark-brown instead of fawn. The nose-leaf is of about the same height as above species; the tail, however, is 0.25 of an inch shorter. The dentation is similar.

The *M. mexicana*, Saussure, is a species from Mexico described by M. Saussure in Revue et Mag. de Zool., 2d series, XII, 1860, p. 486. The author states that the description is taken from a specimen which was in poor condition. It is difficult to tell from his description whether his species is the same as *M. californicus* or not.

Measurements of an average of four individuals.

	Milli- meters.
Length of head and body (from crown of head to base of tail).....	39
Length of head.....	22
Height of ear.....	23
Height of tragus.....	10
Length of arm.....	22
Length of forearm.....	48
First digit:	
Length of first metacarpal bone.....	4
Length of first phalanx.....	4
Second digit:	
Length of second metacarpal bone.....	28
Length of first phalanx.....	4½
Third digit:	
Length of third metacarpal bone.....	34
Length of first phalanx.....	14
Length of second phalanx.....	16
Length of third phalanx.....	9
Fourth digit:	
Length of fourth metacarpal bone.....	32
Length of first phalanx.....	13
Length of second phalanx.....	11

	Milli- meters.
Fifth digit:	
Length of fifth metacarpal bone.....	35
Length of first phalanx.....	12
Length of second phalanx.....	9
Length of thigh.....	16
Length of tibia.....	20
Length of foot.....	10
Length of tail.....	27

Measurements from first edition of Monograph.*

Current number.	From tip of nose to tail.	Length of tail.	Height of nose-leaf.	Length of forearm.	Length of tibia.	Length of longest finger.	Length of thumb.	Height of ear.	Height of tragus.	Expanse.	Nature of specimen.
	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>	<i>Ins.</i>	
2347	2.3	1.6	0.2	1.10	0.9	3.3	0.5	1.1	0.5	10.0	Alcohol.
5214	2.0	1.3	0.2	1.8	0.8	3.0	0.5	1.0	0.4 $\frac{1}{2}$	10.0	Do.
5214a	2.0	1.4	0.2	1.10	0.10	3.2	0.4	1.2	0.5	10.0	Do.
5214b	2.0	1.3	0.2	2.0	0.10	3.0	0.5	1.0	0.4 $\frac{1}{2}$	10.0	Do.
5214c	2.0	1.2	0.2	2.0	0.8	3.0	0.5	1.0	0.5	11.0	Do.
5214d	2.0	1.4	0.2	1.8	0.10	3.0	0.5	0.11	0.4	10.6	Do.
5214e	2.0	1.4	0.2	1.9	0.9	3.0	0.5	1.0	0.6	11.0	Do.
6174	2.0	1.3	0.2	1.8	0.8	3.0	0.5	1.0	0.5	10.6	Do.

Macrotus bulleri H. Allen.—The following description of a Mexican species of *Macrotus* may prove to be of value in studying *M. californicus*, and is therefore introduced at this place. The original can be found in the proceedings of the American Philosophical Society, 1890, Vol. XXVIII, p. 72.

In Article XVI, extracted from the Bulletin of the American Museum of Natural History, Vol. II, No. 3, p. 166, entitled "Notes on a collection of Mammals from Southern Mexico," by Dr. J. A. Allen, occurs the following statement:

Macrotus californicus, Baird.—Eight skins and skulls and three additional skulls, all males. Bolanos, Jalisco, July 3, 1889. "Occurs in immense numbers in the adits and old mine drifts of the Mineral de Bolanos. Of the fourteen captured all were males, whereas in the case of the other kinds of bats taken here females generally predominate." (Audley Buller, MS. notes.)

In the absence of specimens for comparison, it is difficult to say certainly whether they are the same as the California specimens. Judging by descriptions, they are somewhat darker in color.

I had an opportunity through the courtesy of Dr. Allen of examining two of the specimens of this series, and concurred with this authority in considering them to be identical with *M. californicus*. The skins were of immature individuals and the parts about the auricle apparently mutilated. The hair was furnished with dark cinereous tips, a character which, while in striking contrast with the more northern form of the species, was not thought to be distinctive for southern examples of other species, as *Artibeus perspicillatus* and *Atalapha noreboracensis* are differently colored from northern individuals. The main measurements were the same. But since Dr. Allen published his

* See Preface.

notes I have carefully soaked one of the skins in diluted spirits and have detected that the apparent mutilations of the auricle are due to distortion, and that the form of the auricle is sufficiently pronounced to warrant a careful examination of the cranium.

Dr. Allen has sent to me eight crania for inspection. The characters of these specimens are in many respects quite different from those of *M. californicus*. The following is the description of this new species:

Auricle scarcely longer than head; the internal basal lobule rudimental and projects about a millimeter beyond the juncture of the interauricular membrane. External basal lobe reduced to a thin ridge which leaves the tragus exposed. Tragus with convex anterior border for basal two-thirds, and an abruptly acuminate apical third. The outer border is straight—apparently without basal notch or lobule.

The nose-leaf without well-defined lower border—scarcely longer than the face. Chin apparently without divided plate.

Skull.—Facial region without depression on the frontal bone; indeed, it is faintly ridged posteriorly; region over ethmoid scrolls scarcely inflated. Squamosal portion of zygoma not more than one-half the size of the same part in *M. californicus*. No projection of vertex at occiput, but the entire superior curvature of the head simple. Angle of mandible projects scarcely at all back of the condyloid surface. The two halves of the mandible closer together than in *M. californicus*.

Teeth.—The lower premolars are more crowded than in *M. californicus*. The palatal portion of the upper canine is produced to a point posterior to the lateral incisor.

Fur.—On the back the basal two-third is white, the apical third very dark plumbeous, the tip tending to gray. These distinctions are best defined on the sides of the neck. At the middle of the back the gray tip is absent. The colors undergo no variation over the posterior surface of the prebrachium, the humerus, or the rump. On the endopatagium the hairs are shorter, sparsely developed, and of a fawn color throughout.

On the venter a disposition exists for the basal two-thirds of the hair to be whiter than the rest of the hair. This is most marked on the sides of the trunk, and is nearly absent at the middle. The apical third is less markedly plumbeous and the tip is more gray than on the back. On the whole the venter gives the impression of being gray, and the back as being of a dark, sooty hue.

The posterior surface of the auricle covered with short unicolored gray hair which extends upward along the median border nearly its entire length. The hair extends both on the back and the venter over the fleshy part of the forearm.

Two immature examples (the distal epiphyses of the metacarpal bones of the third, a fourth, a fifth, manual digits ununited) 2004, 2005 (Am. Mus., N. Y.), from Bolanos, Jalisco, Mexico.

Measurements.

	Millimeters.
Height of auricle from vertex	7
Height of tragus (slightly distorted)	6
Height of nose-leaf	7
Length of forearm	44
First digit:	
Metacarpal	4
First phalanx	4
Second phalanx	2
Second digit:	
Metacarpal	45
First phalanx	5
Third digit:	
Metacarpal	32
First phalanx	15
Second phalanx	15
Third phalanx	9
Fourth digit:	
Metacarpal	31
First phalanx	14
Second phalanx	11
Fifth digit:	
Metacarpal	33
First phalanx	14
Second phalanx	10
Length of femur	15
Length of tibia	16
Length of foot	13
Length of tail	25
Length of free portion of tail	3½

Genus **ARTIBEUS** Leach.

Artibeus Leach, Trans. Linn. Soc., London (1822), xiii, 75; Peters, MB. Akad. Berlin, 1865, 356; Alston, Biol. Centrali-Amer., Mam., 1879-'82, 47.

Madatus Leach, l. c., 81.

Artibeus Gray, Mag. Zoöl. and Bot., 1839, II, 487.

Pteroderma Gervais, Exped. du Comte de Castelnau, Zoöl., 1855, 34.

1. *Artibeus perspicillatus* (Linnaeus). (Plates III, IV, V.)

Vespertilio perspicillatus Linnaeus, Syst. Nat., 7th ed., 47; Schreber, Säugethiere, 1775, p. 160, Pl. XLVI.

Phyllostoma perspicillatum Geoffroy, Ann. du Museum, xv, 1810, 176, Pl. xi; Wagner, Schreb. Säugeth., Suppl., I, 1844, 402; v. 1855, 631.

Artibeus jamaicensis Leach, Trans. Linn. Soc. London, XIII, 1822, 75.

Madatus lewisii Leach, l. c. p. 82.

Phyllostoma supercillatum Wied, Beitr. zur Naturgesch. Brasil, II, 1826, 200.

Artibeus perspicillatus Gray, Mag. Zoöl. and Bot., 1839, 487.

Artibeus carpolegus Gosse, A Naturalist's Sojourn in Jamaica, 1851, 151.

Pteroderma perspicillatum Gervais, Exped. du Comte de Castelnau, Zoologie, 1855, 34, Pl. VIII, Fig. 7; Pl. X, Fig. 1 (teeth).

Artibeus perspicillatus, Peters, MB., Akad. Berlin, 1865, p. 356; (1) Maynard, Bull. Essex Inst., 1872, 137; Dobson Cat. Chirop. Brit. Mus., 1878, 519; Alston, Biolog. Centrali-Amer., Mam., 1879-82, 47.*

Artibeus is intermediate between *Uroderma* and *Dermanura* and the three genera are in close alliance. Peripheral characters such as those of the auricle and nose-leaf are of doubtful value. The small third lower molar separates *Artibeus* from *Dermanura*, as the absence of the third upper molar separates it from *Uroderma*.

All of the three genera named can be distinguished from *Vampyrops* by the shape of the first lower molar. In *Vampyrops* the protoconid is greatly elevated, while the anterior border of the tooth is not prolonged.

Diagnosis.—Nose-leaf smooth, with entire margins and a broad longitudinal ridge, which is discernible on both anterior and posterior surfaces; lower portion, as a rule, not free at any part from the upper lip. Infra marginal tubercles at the mentum more than three in number.† Mentum provided with a large central wart, on either side of which is placed a smaller wart; the whole arrangement is surrounded by a semicircular row of nodules. Interfemoral membrane scanty, deeply emarginate, without tail.

Molars broad without Vs and exhibit a disposition to become cuspidate on outer and inner borders. Upper middle incisor broad and straight.

Dental Formula.—Molars, $\frac{2}{3}$; premolars, $\frac{2}{2}$; canines, $\frac{1}{1}$. incisors, $\frac{2}{2} \times 2 = 30$.

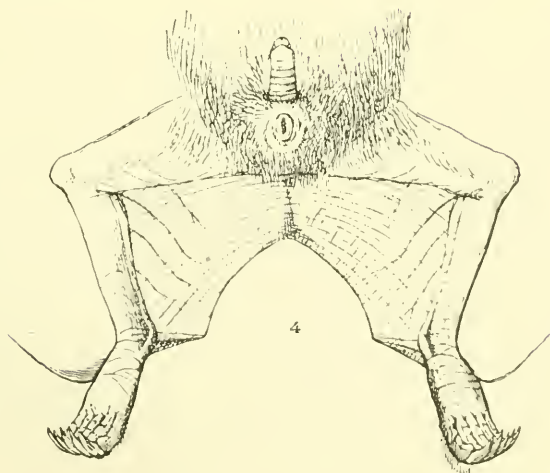
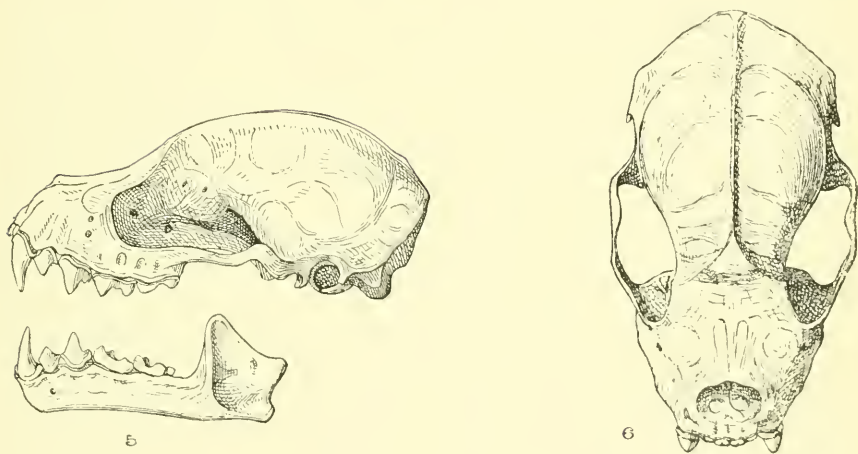
Description.—General form massive; the body heavy; the head with broad transverse diameter. Auricles small, separate. Each auricle when laid against the face reaches the external canthus. The inner border is markedly convex and continued in a single curve with the broad internal basal lobe. The outer border is straight, with a number of transverse lines on each. The hem is one-third the width of the auricle at its broadest part and is continuous below with the rounded broad external basal lobe. A conspicuous external basal ridge is present. The tragus in height equals the distance from the tragus to the eye. It is erect, slightly convex on inner border, almost straight in the inner, and thickened along the median surface, which is usually coarsely spinose inferiorly. The basal notch broad, with a spine at the upper border the basal lobe. A fold of skin extends obliquely from the base to the face. The nostrils are oval and placed obliquely upward and outward. The ends of the opening are free, but the sides are remarkably foliated. The nose-leaf is thus divided by the nostrils into an upper (supra narial) and a lower (infra narial) portion. Both of

*The synonymy in part has been copied from Dobson's Catalogue of the Chiroptera in the British Museum.

†In two specimens of *Dermanura cinerea* examined, the sides of the nose-leaf were concave, the posterior surface of the nose-leaf was without trace of longitudinal ridge, and the infra-marginal tubercles were three in number.

EXPLANATION OF PLATE III.

- FIG. 1. Front view of head of *Artibeus perspicillatus*.
FIG. 2. Side view of same.
FIG. 3. View of tragus and inner surface of auricle.
FIG. 4. The interfemoral membrane.
FIG. 5. The skull and the lower jaw seen from the side. x 2.
FIG. 6. The skull seen from above. x 2.
FIG. 7. The os petrosa. x 4.



ARTIBEUS PERSPICILLATUS.

these are vertically disposed—the latter lying in advance of the former. The upper nostril-border is obliquely disposed to form a fleshy band which widens to form the lateral margin of the naked, erect nose-leaf. These margins tend to unite at the posterior surface of the tip of the mid-rib. Lying between the nostrils is a tubercle; above this is a broadly ovate, convex mid-rib. A similar mid-rib is seen on the posterior surface. This “fer de lance” is spoken of in general zoological writings as the erect part of the nose-leaf. The infra-narial outgrowth is disposed laterally. It also is naked, conforms to the large, crescentic mass of muzzle-glands, and is coarsely sinuate on its free margin. It unites with the posterior surface of the supra-narial portion at the point where this leaflet frees itself from the head. Below it unites with the fellow of the opposite side across the muzzle by a row of obscure nodules which may form a ridge. A few hair-bearing warts lie in the space between the muzzle-glands and the eye. The upper lip is bordered throughout with marginal papillæ; the lower lip is free from the mandible its entire length, and furnished with papillæ at the sides only. Near the mentum the papillæ become coarser, and in front of the incisors form a distinct row which is arranged in the form of a semicircle round a distinct, undivided chin plate. The eye is large and conspicuous. The calcar is short, about the length of tarsus; tail none.

Variations.—The lobe at the free margin of the basal portion of the nose-leaf may be conspicuous or almost absent; a faintly marked crescent of minute warts may lie on either side of the upper lip, in some specimens the basal part may be without tubercle. The external basal lobe of the tragus may be nearly quadrate. The spines on the outer border of the tragus proper are subject to much minor variation.

Coloration.—The color of the hair of this species is subject to great variation,* a circumstance which probably accounts for the number of species which have been proposed. The material at hand has not been sufficient to satisfactorily determine the ranges of variation. I will rest satisfied in defining some of the more marked characteristic types of coloration.

The prevalent shades, however, are not very broadly differentiated. Fawn, deep sienna brown, mouse-gray with various shades of ashy white tips to the hairs, being the prevalent hues. The degree to which the hair is unicolored or bicolored is also inconstant. Unfortunately the exact localities from which material has been collected in many instances are not known.

In the specimen No. 11187 N. M., Mirador, Mexico, the fur of the crown was white; the longitudinal streaks usually present in *Artibeus* were apparently absent, but in reality they formed the lateral boundaries of the crown. The occiput and back were of a light-gray brown at tip, while the main portion of the hair much lighter. Over the sacrum

*Dr. J. A. Allen (Bull. Am. Mus., 1891) enters into a careful comparison of this species from the West Indies, Bolivia, and Bogota.

the hair was almost white without brown tips. The face was provided with light-brown hair verging to white. The inter-ramal space was white; so also was the front of the neck. The same color extended over the middle of chest. The rest of chest and abdomen was of a light shade of fawn, with ashy tips to the hair. The fur was slightly thinner over the front of the trunk than at the sides. The side of the neck was of the prevalent color of the back. On each side the lower part was covered with white tips to the hair, thus simulating shoulder tufts.

No. 5206, N. M., from Cuba, showed the same coloration as above, excepting that the crown was brown and the lateral stripes were scarcely discernible.

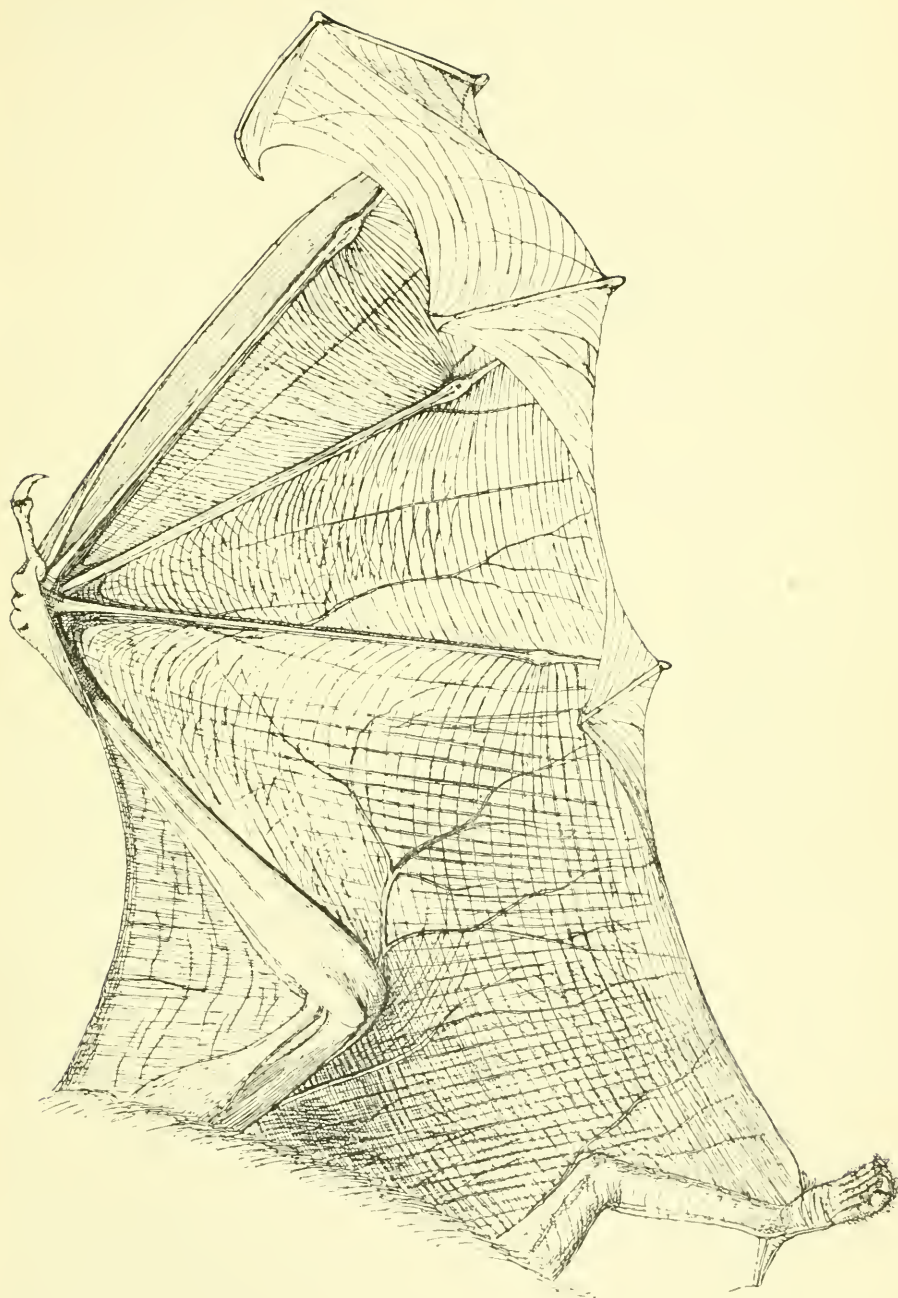
In the second example the color was the same as above, excepting the fur was less white on the back. The crown was of a brown color and the two lateral stripes were distinct. The region of the sacrum was also brown in color.

In specimen No. 13320 N. M., the fur was everywhere of a rich sienna brown, and was unicolored. The lateral stripes on the head were distinct. A small linear tuft extended from the base of the tragus to the external canthus. A long fringe of hair laid in front of the auricle.

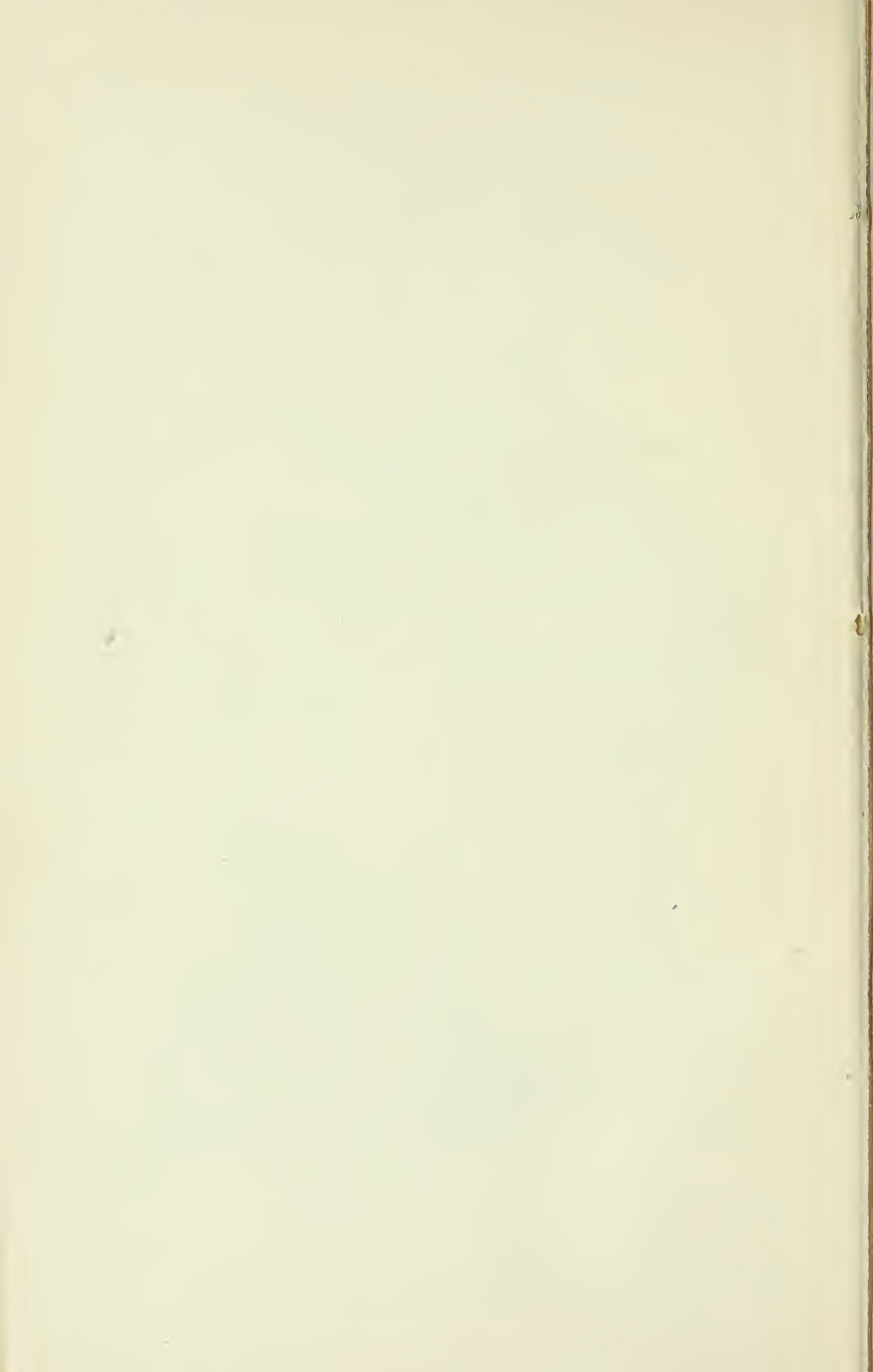
In a third individual a few sparsely distributed hairs were seen on the venter of the antibrachium, a distinct row projecting over the free margin. The dorsum of the forearm from near the elbow to the middle was covered with a sparse growth of short hair, which was directed downward and backward. The venter of the forearm exhibited a similar disposition; the hair was confined to the fleshy portion. The dorsum of the first metacarpal bone was occupied by a few hairs. The dorsum of the endopatagium was covered with hair in the angle between the lower border of the thorax and the arm near the elbow. On the venter it extended as a thin layer from the lower end of the biceps to near the upper third of the thigh.

Prof. B. G. Wilder, of Cornell University, kindly sent me for examination a specimen, which bore a general resemblance to those from the National Museum. No hair, however, was on the forearm or on the dorsum. The hair over the ventral aspect of biceps muscle and along the side of the trunk to the pubis was much darker than elsewhere, and was of a ashy brown color. On the dorsum of the head the color was white; thus the linear streaks were apparently lost. The chest and loin were of a light brown at the tip, yellow brown in the middle, two-fourths and plumbeous at the basal fourth.

A second example from the same source showed the color to be a general dark brown; the stripes were well defined; a white patch was seen at the base of each auricle posteriorly; the back was provided with a long lustrous brown hair, unicolored for the most part, but showing paler shafts over the scapulae. Below the fur was much darker than



WING MEMBRANE OF ARTIBEUS PERSPICILLATUS.



above, and unicolorous save at the tips, which is distinctly cinerous. The fleshy part of the forearm was covered with hair, which was directed toward the elbow. The dorsal surface of the first metacarpal bone was marked with a small clump of hair.

In two specimens collected by the expedition of the Philadelphia Academy of Natural Sciences at Uxmal, Yucatan, in 1889, the general appearance of the venter was mouse-gray beneath, with silvery tips to the hair, and that of the dorsum was darker and without gray, except the two faint stripes on the head. The head and neck were for the greater part white, the tip alone being ash gray. The white lines on the head were inconspicuous. On the side of the neck the hair was of the above type, but much longer. The front of the neck was nearly unicolorous, the basal one-fifth alone being white. The dorsum was dark lustrous and unicolorous at the loin. The venter was provided with distinctly ashy appearance of the tips, but the rest of the fur was ash brown.

Membranes.—The prebrachium with free margin occupied with a band 1^{mm} wide, which apparently represents the tendon of the occipito-pollicis muscle; intercostal markings conspicuous, four in number; the lowest is the largest and extends as far as the ankle. The oblique line, which passes upward and outward as far as the ankle on the mesopatagium in many genera, is here absent. The line of the fascicle of the coracobrachialis is conspicuous and extends to a point in a vertical line with the elbow. The lines of the vertical platysma fascicles are about thirty in number. The system into which the triceps-fascicle enters extends as far as the end of the fifth digit. It is composed of three divisions, a vertical, oblique, and a horizontal. The fourth interspace is provided with a faintly marked longitudinal line, which begins at a point 22^{mm} from carpus and extends to a point 10^{mm} from the free margin of the membrane. The pre-digital nerve appears at the middle of the fifth metacarpal bone, and is larger than the post digital, which appears at the metacarpo-phalangeal joint of the third finger. The third interspace is also provided with a longitudinal line. It extends from near the palm and reaches to within 10^{mm} of the free margin of the membrane. A nerve appears at the metacarpo-phalangeal joint of the fourth finger and lies obliquely across the lower part of the interspace. The fourth phalanx of the third digit is sickle shaped, the membrane being to its tip; that of the fourth digit is of the shape of an inverted T; that of the fifth is triangular, the angle, which is directed toward the body, being prolonged.

Skull.—The skull is massive, broad, as compared with other crania in the order. Concave muscular impressions are defined in the region directly back of the temporal bone. The mastoid process is longer than the paroccipital. The tympanic bone is complete above, though the suture between the two parts is conspicuous. The bone is small as compared with the same part in other genera; it recedes slightly from the free border of the squama, and as seen from below leaves the cochlea

exposed for a distance slightly in excess of its own width. The sphenoidal tongue is not deflected from the level of the basisphenoid. The infraorbital foramen, as a rule, is doubled. The posterior border of the vomer is almost on a level with the posterior edge of the hard palate. The angle of the mandible is slightly deflected outward. The lachrymal canal, as seen in the orbit, is exceedingly small and in some examples is apparently absent. In large specimens a rudiment of the postorbital process is present and the anterior border of the temporal fissure is trenchant.

Nasal bones without median depression.* The shape of the zygoma is subject to considerable variation; the depth of the notch on the upper border and the height of the arch midway between the maxillary squamosis processes being inconstant proportions. The styloid process is relatively of great length and projects into the substance of the tongue. From an average of measurements of three specimens, the following was secured:

Length 28^{mm}; length of superior dental series 11^{mm}; outside measurement of the width of the dental arch at the first upper molar 13^{mm}; width of the base of the cranium at the glenoid region 15^{mm}; the length of the face from the postorbital processes 9^{mm}; the length of the mandible 18^{mm}; the height of the coronoid process 3^{mm}.

The arrangement of the turbinals in *Artibeus* is as follows: The ectoturbinal is exceedingly slender and is furnished with a fleshy summit, which is convolute outward. Its upper portion alone is seen from the median surface. The first endoturbinal is free below but fleshy above. It is produced forward one-half its length beyond the end of the ectoturbinal in the form of a lobule, is acuminate, and possesses, as in *Dermanura* a small posterior lobe. The second endoturbinal is concealed by the third. When the latter is pressed aside at its upper part the small biconvolute plate of the second plate is seen in position. The third endoturbinal possesses a large lobule, which lies upon the median surface. The lobule is subrounded in form, completely occupying the upper edge of the plate so that it appears to arise from the cribriform by a pedicle. The fourth endoturbinal presents an exposed plate on the median surface. It is beneath the convex nonperforate space and yields a single large convolution, which is turned outward. Although this plate lies back of the cribriform plate the absence of any connection between it and the vomer would seem to show that the arrangement met with in many mammals is departed from.

Four examples of immature crania were studied. No. 1 measured 14^{mm} long and 9^{mm} wide at mastoids. Maxilla articulates with the

*The genera *Uroderma*, *Artibeus*, and *Dermanura* are all characterized by this negative character. In *Vampyrops* a groove-like depression is seen on the dorsum of the face at the upper two-thirds of the nasal bones. This peculiarity enables the observer readily to distinguish the crania of *Uroderma* and *Vampyrops*, notwithstanding that the dental formulae are the same.

nasal at the upper fifth of its outer border, the remaining four-fifths being occupied with the premaxilla. The nasals twice the width above as below, where the free margin is oblique from within outward so that an inverted $\triangle$ -shaped space is defined between them. The frontals separated by a sharply limited median suture; the encranial and facial region in the orbit defined; a fronto-squamosal suture evident: An intermediate ossicle to the squamosal and opisthotic elements is seen at the side of the cranium. The basioccipital and exoccipitals unite as in mammalia generally. The part first named is tilted upward, thus forming the wall of a deep basiscranial depression. The proportions of the tympanic bone and cochlea are as in the adult. The permanent central upper incisors are alone erupted. Five hook-like deciduous teeth are visible. They may be named two incisors, one canine and two premolars. All the permanent lower incisors are erupted. The only hook-like deciduous tooth is one in the position of the canine. The premolars and molars are near the surface of the gum and can be obscurely outlined.

The glans penis is free. The prepuce is reduced to a conical lappet inferiorly.*

Maxillary teeth.—Incisors contiguous or separated by a slight interval. The lateral incisor does not touch the canine tooth. Central incisors with quadrate crown and straight bilobed cutting edge. Lateral incisors subtriangular; crown with concave anterior surface, and oblique, simple, cutting edges. In some individuals these teeth exhibit concave cutting edges and convex lateral borders. The canine is as long as the interval between the two teeth is wide, with low cingulum on all sides except the buccal. The first premolar touches both canine and second premolar or slightly overlaps the latter. The second premolar is larger than the first, with rudiment of protocone. Posteriorly a double buccal contour is seen, with a rudiment of a metacone. The grinding surface of the first molar is elongate, with a slight inclination backward; the protocone is conoidal. Between it and the scarcely fluted buccal aspect a smooth, deeply concave surface is seen. With the exception of an irregular double basal contour all trace of the conoidal shape of the paracone and metacone is lost. The inner of the two lines is often incomplete (see figure). The hypocone is conoidal and well developed. On the buccal surface the positions of the paracone and metacone are well defined, conspicuous, and sectorial. The metacone, which is more especially defined by the inner contour, is coarsely pectinate in some specimens. The second molar is smaller than the first. The inner contour line extends the entire length of the buccal border. The molars are contiguous at their buccal edge only. This

*The value of this character is apparent when compared with *Sturnira*, in which genus the glans is free beneath only—the abruptly truncated prepuce above being adherent almost to the entire upper surface of the glans. In *Brachyphylla* the glans is concealed by an elongate prepuce.

peculiarity is less marked in the young adult than in some of the older animals.

Mandibular teeth.—The incisors are contiguous, blunt, uniform—an interval existing between the anterior and posterior borders of the cutting edges. Canine excavate posteriorly touching the triangular compressed simple first premolar. The second premolar is a third higher than the first. The cingulum is slightly elevated at the base of the main cusp (paraconid) and provided with a small heel (hypoconid). The first molar much larger than the second, quadrate tapering slightly forward. Protoconid marginal, compressed, sectorial, less than twice the height of hypoconid and expanded at base anteriorly. Paraconid trifid, the main cusp conoidal not distinct from cingulum, marginal hypoconid compressed. Entoconid conoidal, conspicuous, marginal, an intermediate tubercle between it and the paraconid. Second molar quadrate, tapering slightly backward. Protoconid not marginal, but a well defined nearly complete cingulum at buccal base, conoidal, with flange at base anteriorly, paraconid obscurely trifid, the main cusp much the longest, hypoconid sectorial, entoconid conoidal, no intermediate tubercle between it and paraconid. The third molar rudimental scarcely larger than one of the lower incisors; blunt, depressed in center of grinding surface: sometimes provided with a partial cingule.

The milk incisors are retained for a longer time than the other milk teeth. They may remain in the jaw, lying to the labial side of the complete set of permanent incisors.

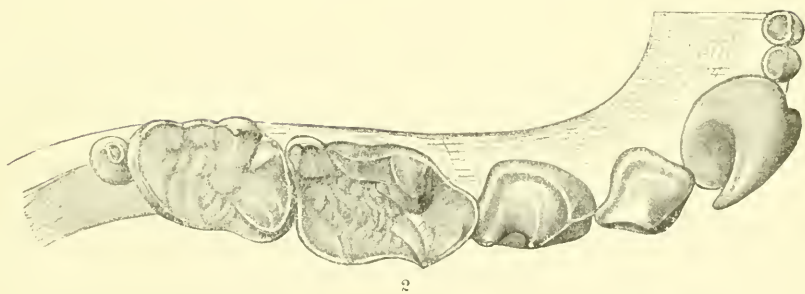
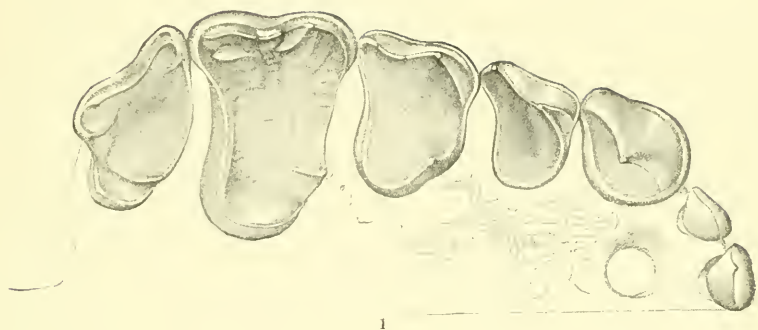
Remarks.—I am not certain about the identification of some of the cusps of the molar teeth in *Artibeus*. Individual variation occurs in the arrangement of the cusps on the lingual aspect of the first and second mandibular molars, which make it likely that they are developments from a cingulum in a tooth from which all traces of the true cusps have disappeared. If this hypothesis be accepted the description is greatly simplified. But it lacks proof, and demands for *Artibeus* a more aberrant position than is suggested by other features in its economy.

The loss of the V-like cusps of the molars, the development of marginal cuspules, the delicate and somewhat elaborate sculpturing on the grinding surfaces combine to make these teeth of *Artibeus* unique.*

After framing the above description I studied the teeth in the allied genera *Centurio*, *Sturnira* and *Brachyphylla*. These notes are herewith appended:

Centurio—The mandibular molars such as in *Artibeus*. The canine deeply con-

*The following notes on the teeth of allied genera will be of value. In *Dermanura* the lower incisors are twice the length of the same teeth in *Artibeus* and *Uroderma*. The upper central incisors in the genus last named are much longer than the laterals, and are furnished with oblique cutting edges much in the same manner as in *Hemiderma* and *Vampyrops*. *Artibeus*, *Dermanura*, and *Uroderma*, are readily distinguished from *Vampyrops* by the presence of a marginal cusp (protoconid) on the anterior half of the lingual aspect of the first lower molar.



1. MAXILLARY TEETH OF *ARTIBEUS PERSPICILLATUS*. X 8.
2. MANDIBULAR TEETH. X 8.

cave on anterior surface. The first premolar much smaller than second, which bears a small denticle on the posterior border. The metacone crenulate on the posterior border. The posterior border is excavated to a point opposite the first molar. The mandibular first premolar is smaller than the second. The first premolar is smaller than the second. The first molar with four simple cusps, the second with three; all are simple and nearly coequal.

Sturnira.—The first maxillary premolar as large as second, not compressed from before backward. The maxillary first and second molars tritubercular, no trace of hypocone. Paracone with a double contour line on concave simple grinding surface. Third molar bicuspidate. The first mandibular premolar much wider than second, but of the same height. The first molar larger than second. Paracone is simple, conoidal, marginal with cuspidate commissure so high on lingual border as to resemble a distinct cusp; endoconid same as paraconid. These three cusp-like points are visible from lingual aspect of tooth. Hypoconid scarcely smaller than protoconid but not conoidal. Third molar obscurely tritubercular.

Brachyphylla.—Large posterior basal cusp on posterior border of canine; first premolar minute entirely outside of axis of tooth-row. Second premolar with well defined palatal basal lobe (protocone) which is continuous with flutings which extend to apex of conoidal crown which almost reaches level of canine. First molar slightly smaller than second; tritubercular protocone oblique with intermediate cusp between it and metacone. Paracone and metacone subequal (the former being the larger) sectorial and irregularly fluted on palatal sides. Second molar as first but the protocone is straight, *i. e.* parallel to buccal border, no intermediate cusp on crown but a large marginal cuspule on buccal side between the subequal paracone and metacone (the latter being the larger.) The third molar one-half the size of the first with well defined anterior and posterior commissures. The mandibular premolars subequal, the posterior with a longer heel. The mandibular molars quadritubercular, cusps well defined, crown not excavate.

Notes on the skeleton.—Atlas with inconspicuous or no tubercle on body. No spines on the lower border of the transverse process.

Axis with very small transverse process, which bears no foramen to outside of the foramen for the vertebral artery. No tubercle on the keel on the ventral aspect of the centrum.

Scapula.—The coracoid process scarcely curved and the free end not reaching a point below the level of the glenoid cavity. The free end of the spine angulated. The infra-spinous fossa slightly deepened at the axillary border. The inner tubercle of the humerus slightly raised above the head.

Humerus.—The convexity of the trochlea well defined, broad in front; median concavity deeper behind than in front; the same is true of the limiting ridge; the lateral concavity is weak and not produced back of the longitudinal axis of the humerus. Epicondyle horizontal, conspicuous; no spine on the under surface; no median pit on the shaft beneath the epicondyle.

The radius with a spoon-shaped distal articular surface with markedly-developed side flanges. The biceps impression occupies entire lateral surface of the shaft. The surface for articulation of the ulna is broad above, narrow below, and is throughout irregular.

The proximal rudiment of the ulna is free at the olecranon, but ankylosed with the radius a little above the middle of the shaft. The distal rudiment is a small, hatchet-shaped tubercle.

The trapezium is three times as large as and covers and conceals the trapezoid. It presents a large spheroid surface for first digit, but yields a superficies on same general surface, which is without facet. Proximal surface with dorso-ventral ridge. The trapezoid is sigmoid, slender. The magnum recalls general shape in man; the distal end is large and oblique. The unciform is irregularly prismoidal, with large lateral sigmoid articular notch. The carpus exhibits a flat, scale like element in first row, which remained with the radius in disarticulation.

The second and third metacarpal bones are compressed at proximal articular surface, the second being C-shape and the third spatula-shape. The fourth and fifth are irregularly spinose, the fourth being multiflex, articulation axial; the fifth triflex, articulation lateral.

In both *Artibeus* and *Vampyrus* the entire length of the second digit is not greater than the length of the third metacarpal. Hence the movement of digits of third, fourth, and fifth finger do not affect that of the second digit. In Vespertilionidae (well seen in *Atalapha*) all is different; the second digit of second finger is flexed with the flexion of the entire series. The first metacarpal and the first phalanx of the first digit are as in *Macrotus*. The fifth metacarpal is the longest and the fourth is the shortest. The second phalanx of the third digit is greatly longer than in *Macrotus*; the fifth metacarpal is as long as the forearm. In repose the first digit lies parallel to long axis of the face and above it.

In common with some other phyllostomine bats (*e. g.* *Stenoderma* and *Glossophaga*), some of the elements of the manus are imperfectly ossified, and hence are flexible. The second digit, the second and third phalanges of the third and fourth digits exhibit this property.

Remarks on measurements.—The fourth metacarpal bone is shorter than the third and fourth. In the type the three bones are of the same length. The thumb, face, tragus, and foot are as large as in the type, while the forearm, auricle, head, trunk, thigh, and leg are smaller. The phalanges of the manus (excepting those of the thumb) are longer, proportionately to the length of the forearm, than in the type. Hence, the thumb, forearm, head, auricle, phalanges, thigh, and leg are variable quantities, while the tragus, face, and foot are fixed.

The females range somewhat larger than the males. In four females the average length of forearm was 70^{mm}. In six males it was 66^{mm}.

Habitat.—Neotropical America.

The reasons for including *Artibeus perspicillatus* in this monograph are derived from a statement of Mr. C. F. Maynard (Mammals of Florida, p. 22). This writer reports the existence of the species in Florida. The following extract is taken from Mr. Maynard's paper:

While at Key West in the early winter of 1870 I observed several large bats flying about the city, which closely resembled in flight a species which I had seen in northern Florida two years before, but which flew so high that I was unable to shoot them. I was very anxious to obtain a specimen, but as shooting was prohibited in the streets of the city of Key West, and as I never saw the bats elsewhere on the island, I feared that I should be obliged to go away without one. I was, there-

fore, agreeably surprised one morning to see a boy enter my room with a bat in his hand which, from its large size, I knew could be no other than the species which I had so long desired to obtain. He said that he had found it hanging upon the leaf of a tree and had killed it with a piece of limestone. This is, I think, the first instance on record of a bat of this form being taken on the Atlantic slope. This species, without doubt, inhabits the whole of Florida. They fly early in the evening, often before sunset, and, as has been remarked, usually very high.

None of the bats of Florida appear to hibernate, or at best they only remain quiet during an occasionally cold night.*

Measurements.

	U. S. N. M. 11187. Mirador, Mexico.	U. S. N. M. 13220.	A. N. S. P. Exped., 1889. Yucatan.
	<i>mm.</i>	<i>mm.</i>	<i>mm.</i>
Length of head and body (from crown of head to base of tail)....	68	69	65
Length of arm.....	29	30	25
Length of forearm.....	57	66	2
First digit:			
Length of first metacarpal bone.....	5	4½	4
Length of first phalanx.....	6	6½	5
Second digit:			
Length of second metacarpal bone.....	41	51	41
Length of first phalanx.....	4½	5	9
Third digit:			
Length of third metacarpal bone.....	51	62	49
Length of first phalanx.....	16½	21	17
Length of second phalanx.....	30	37½	28
Length of third phalanx.....	16	20	13
Fourth digit:			
Length of fourth metacarpal bone.....	50	62	47
Length of first phalanx.....	13	20	16
Length of second phalanx.....	20	26	19
Fifth digit:			
Length of fifth metacarpal bone.....	51	62	47
Length of first phalanx.....	11	17	11
Length of second phalanx.....	11	19	15
Length of head.....	30	34½	29
Height of ear.....	11½	16	13
Height of tragus.....	6	6	6
Length of thigh.....	19	17	15
Length of tibia.....	24	20	20
Length of foot.....	13	13	10

Family VESPERTILIONIDÆ.†

Genus **CORYNORHINUS** H. Allen.

Corynorhinus H. Allen, Proc. Acad. Nat. Sci. Phila., 1865, 173.

Plecotus Leconte, Cuvier's Animal Kingdom (McMurtries' ed.), App. 1831, 431;

Cooper, Ann. Lyc. Nat. Hist. New York, 1837, 72, 73; Dobson, Cat. Chirop.

Brit. Mus., 1878, 180.

Synotis H. Allen, Monog. N. A. Bats, 1864, 63.

Diagnosis.—Ears with internal basal lobe not entire but almost aborted near the headfold. Nostrils with no trace of nasal cornu. The

* This paper appeared in the Quarterly Journal of the Boston Zoölogical Society, vol. II, 1883. Mr. Maynard kindly sent me a drawing of the bat he describes. I have no hesitation in identifying it as *Artibeus perspicillatus*.

† VESPERTILIONIDÆ. Bats with volute turbinals of the ethmoid bone; premaxillæ without palatal processes forming a median suture, but in its place a wide interspace which includes the incisive foramen of other types; no speno-palatine foramine; trapezium with palmer tubercle, and hence thumb erect, *i. e.*, not inclined to flexion on palm; wings adapted for a rapid irregular flight, and animal for

margins of the dorsally directed aperture everted, the lower outer angle being grooved. The facial clump of glands back of the muzzle elevated into club-shaped masses. Sphenoidal foramen at the bottom of a deep recess. A well-defined hem of membrane between thumb and the second digit. The fifth digit greatly longer than the forearm. The palmar aspect of digits in undissected specimen with outlines defined at proximal ends. The terminal cartilage of the fourth digit axial, small.

Dental Formula—Molars $\frac{3}{3}$, Premolars $\frac{3}{2}$, Canines $\frac{1}{1}$, Incisors $\frac{2}{3}$, $\times 2 = 36$ teeth.

Membranes of the second digital interspace is attached to the ventral border of the third metacarpal bone; that of the third interspace to its dorsal border.* The thumb is semiflexed, callosity rudimental; phalanges disposed to curve forward in flight. The second phalanx of the third digit is longer than the first. The otic capsule much as in *Antrozous*; the external semicircular canal is free from bone. The tympanic bone appears to be united to the capsule (*os petrosa*).

Corynorhinus differs markedly from *Antrozous* in the greater development of the hypocone in both upper and lower molars and in the less rudimental form of the third maxillary molar. The points of the cusps are all more produced than in the genus named.

Since some writers (vide Dobson l. c.) do not accept *Corynorhinus* as a valid genus but assign the species to *Plecotus* the following diagnosis of this genus is given. *Plecotus*: the first phalanx of the third, fourth, and fifth digits, longer than the second. Nostrils, as in *Vespertilio*, i. e., with a well-defined cornu and a lunate aperture. The internal basal lobe of the ear entire. The tragus foliate scarcely tapering above. The sphenoidal foramen not at the bottom of a deep recess. The clumps of gland-masses on the snout not raised, indeed, are smaller than in most genera of the family.

The following is the manual formula:

	Milli- meter.
Second interspace.....	2½
Third interspace.....	12
Fourth interspace.....	20
Forearm.....	38

The material available for study of *Corynorhinus* was unsatisfactory. I have three examples of *C. macrotis*—one of them immature—two alcoholics. Of *C. townsendii* I have four examples in alcohol, all adult.

both aerial and terrestrial progression; ulna with small proximal rudiment rarely forming a well-defined shaft which is ankylosed to the radius (Kerivoula), but usually forming a filament which ends among the muscles of the forearm; accessory cartilage to the fifth digit present except in *Plecoti*; coracoid as a rule bifid (exceptions in *Plecoti* and *Antrozous*); raised folds of skin at the junction of the carpus and metacarpus (except in *Plecoti*); oblique line on the wing membrane at the lower third of the tibia; nose-leaf absent; tail inclosed in the ample interfemoral membrane, or the last joint alone projecting; hypocone rudimental or absent; the paracoid, metaconid, and hypoconid large, subequal.

* Same as in *Antrozous*.

The Vespertilionidæ have hitherto embraced all the small naked-nosed bats not included in the molossine and emballanurine groups. I have elsewhere* given reasons for assigning *Natalus* to a separate family in close alliance with the phyllostomine bats, notwithstanding that the nose-leaf (at least in the adult) is absent. I have no doubt that *Thyroptera*, *Corynorhinus*, *Enderma*, *Noctilio*, and *Antrozous* are also to be separated from the true vespertilionine forms. The intervals between these outlying genera are unequal. *Thyroptera* is in close relation to *Natalus*; *Corynorhinus* to *Enderma*. Yet the exhibition of phyllostomine characters, suggest that these genera are aberrant expressions of the leaf-nose types, and are probably the forerunners of the genera of the group in which *Atalapha*, *Vespertilio*, *Adelonycteris*, *Vesperugo*, *Lasionycteris*, and *Nycticejus* are found.

Noctilio exhibits phyllostomine affinities, but approaches more nearly to the molossine than to the vespertilionine group, though the genera *Noctulinia*, *Miniopterus*, and *Chalinolobus* may here be said to occupy an intermediate position.

Antrozous in like manner can be shown to have originated from a phyllostomine stem, though probably at points independent of either of those above named.

1. *Corynorhinus macrotis* (Leconte). The Big-eared Bat. (Plate VI, VII).

Plecotus macrotis Leconte, Cuv. Animal Kingdom (McMurtries' ed). Appendix 1, 1831, 431; Dobson, Cat. Chirop. Brit. Mus., 1878, 180.

Plecotus lecontei Cooper, Ann. Lye. Nat. Hist., N. Y., IV, 1837, 72.

Synotus lecontei Wagner, Schreb. Säugeth., Suppl. v., 1855, 720.

Synotus macrotis H. Allen, Monog. N. A. Bats, 1864, 63.

Corynorhinus macrotis H. Allen, Proc. Acad. Nat. Sci., Phila., 1865, 173.

Diagnosis.—Phalanges of the fourth and fifth digits of equal length. The maxillary central incisor not bifid. The post-digital nerve of the fourth interspace arises at a point midway between the distal and proximal ends of the fourth metacarpal.

The following is the manual formula:

Second interspace	3
Third interspace.....	15
Fourth interspace	27
Forearm.....	40

Description.—Ears nearly twice the length of the head; internal basal lobe rudimental, rounded, free inferiorly, but lost in a mere line above and ending on the internal border at the headfold in a small non-projecting tubercle. The internal border moderately convex, turned abruptly backward so as to lie upon the posterior surface of the auricle, and is lost on the headfold. The tip is small, rounded; outer border nearly straight, not incised. The first scallop alone is present; it passes downward and forward to near the angle of the mouth, well to the outside and beyond the external basal lobe, which forms a rounded sharply

*Proc. Nat. Museum.

defined leaflet. The tapering tragus is less than half the height of the auricle; basal notch scarcely defined; basal lobe semicircular, concave above, projecting outward. Nostrils irregularly quadrate, reaching almost to the top of the high muzzle; the borders slightly produced; lower border furnished with a groove; septum absent. Facial glands not extended laterally, but raised toward dorsum of rostrum into a prominent club-shaped mass. Lower lip not moveable, without mental plate.

The coraco-brochialis and triceps muscles not sending fascicles to the wing-membrane.

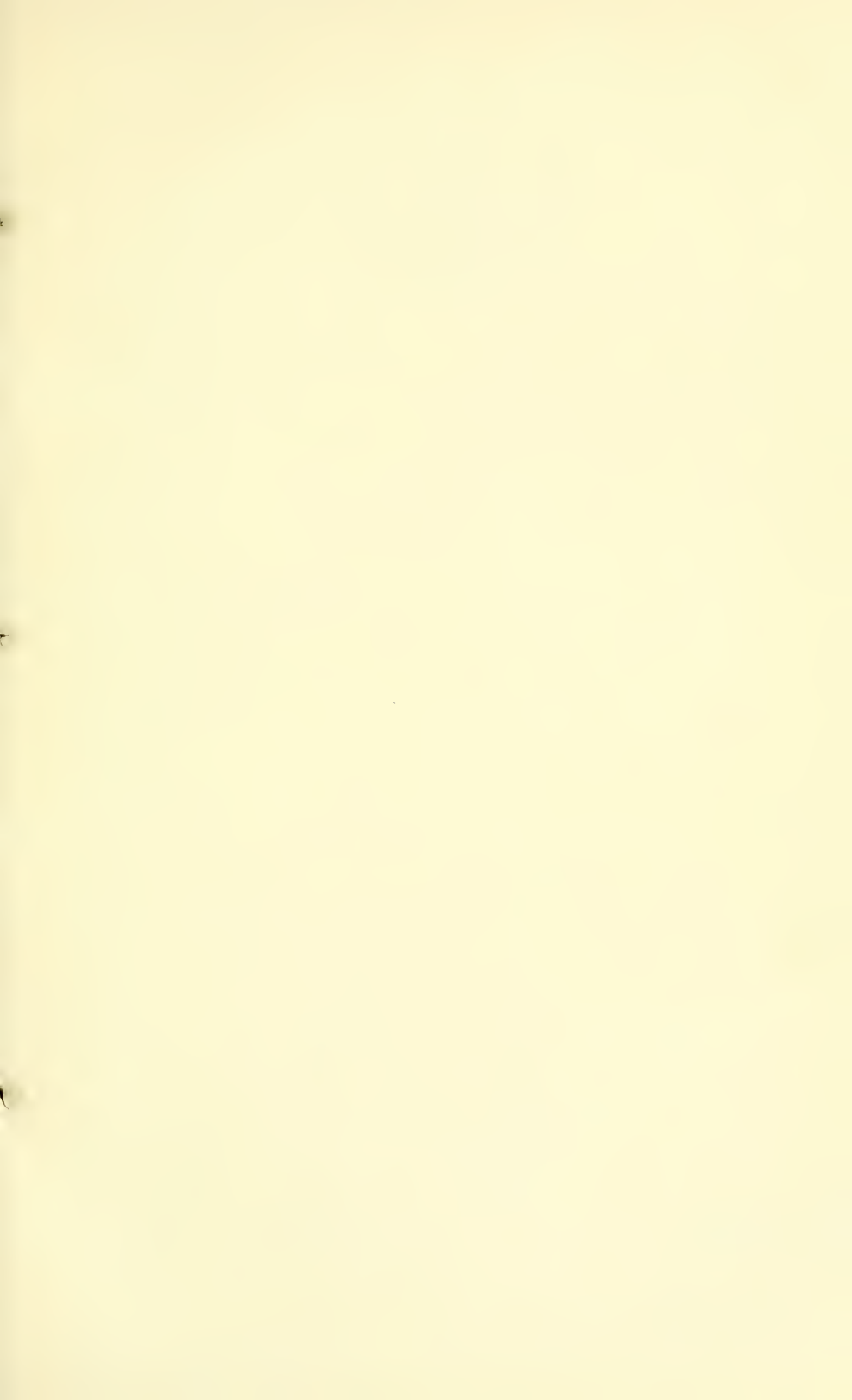
Postdigital nerve arises from the fourth metacarpal bone about midway between the proximal and distal ends. The mesopatagium is provided with a system of muscle-fascicles which are dispersed obliquely from above downward about midway between the forearm and the free margin. Tail just below the pubis is raised from the under surface of the interfemoral membrane; for the rest of its extent it is raised from the upper surface; the tip is not exsert. The calcar is weak, extends less than one-half the length of the free margin of the interfemoral membrane and is without post-calcaral lobe. Foot slender, as long as the thumb.

Fur on the dorsum dark brown at apical one-third; dark ash at basal two-thirds; on the ventre the fur is light gray or white at apical one-third; black at basal two-thirds. A sparse growth of hair is seen on the base of the toes.

Maxillary teeth.—Central incisor bifid-posterior cusp much the smaller. Tooth placed at the edge of incisor notched and presents a convex median border. Lateral incisor with long, aciculate cusp; concave on palatal surface, oblique on lateral border, parallel with central tooth on median border. In other respects the teeth as in *C. townsendii* (q. v.).

Mandibular teeth.—These are the same as in *C. townsendii*, except that the incisors are more crowded.

Skull.—The entire region of the vertex of the region of the mesencephalon is elevated and defined laterally by the weak posterior temporal crests. Greatest length 16^m. Greatest width 8^m to 9½^m. Least width 3^m. Length of mesencephalon 3^m. The length of face from the orbit is 3^m. Greatest height 5.05^m. Thus the height is absolutely greater than in *Euderma*, while the length is much less. The sagittal crest is absent over the posterior half of the vertex and extends to a line which answers to the middle of the auditory meatus; the anterior temporal impressions are faintly defined. The face-vertex with sharply limited pit-like concavity, which is sharply separated from the anterior nasal aperture. The region of the proencephalon is well defined above. The fronto-maxillary inflation is most marked at the region of the orbit, but to a much less degree than in *Euderma*; the orbital ridge is swollen and faintly marked. The facial opening of the infraorbital canal lies 1^{mm} above the tooth row. The outer wall is sharply crested,



EXPLANATION OF PLATE VI.

FIG. 1. Front view of head of *Corynorhinus macrotis*.

FIG. 2. Side view of same.

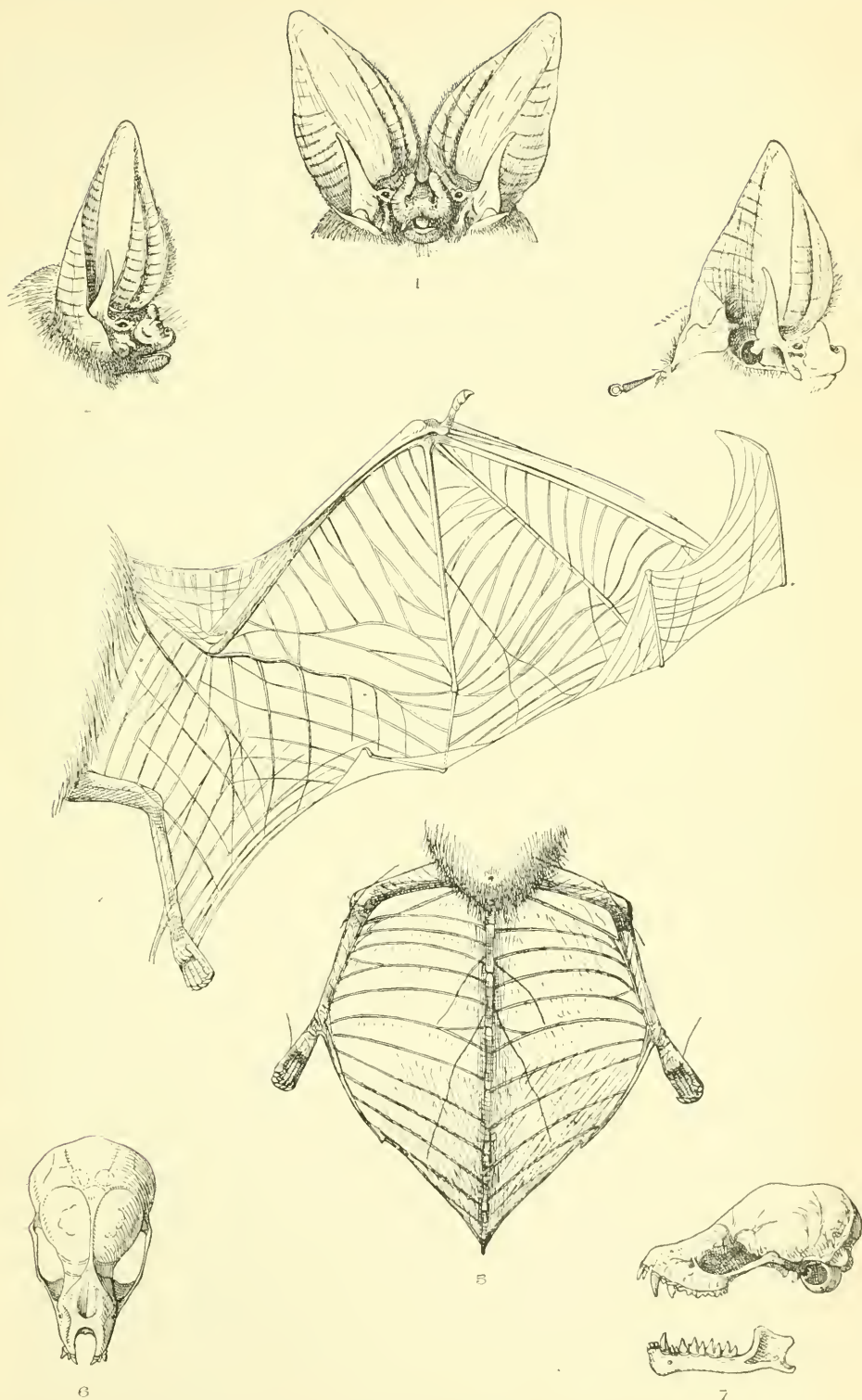
FIG. 3. View of tragus and inner surface of auricle.

FIG. 4. Wing membrane.

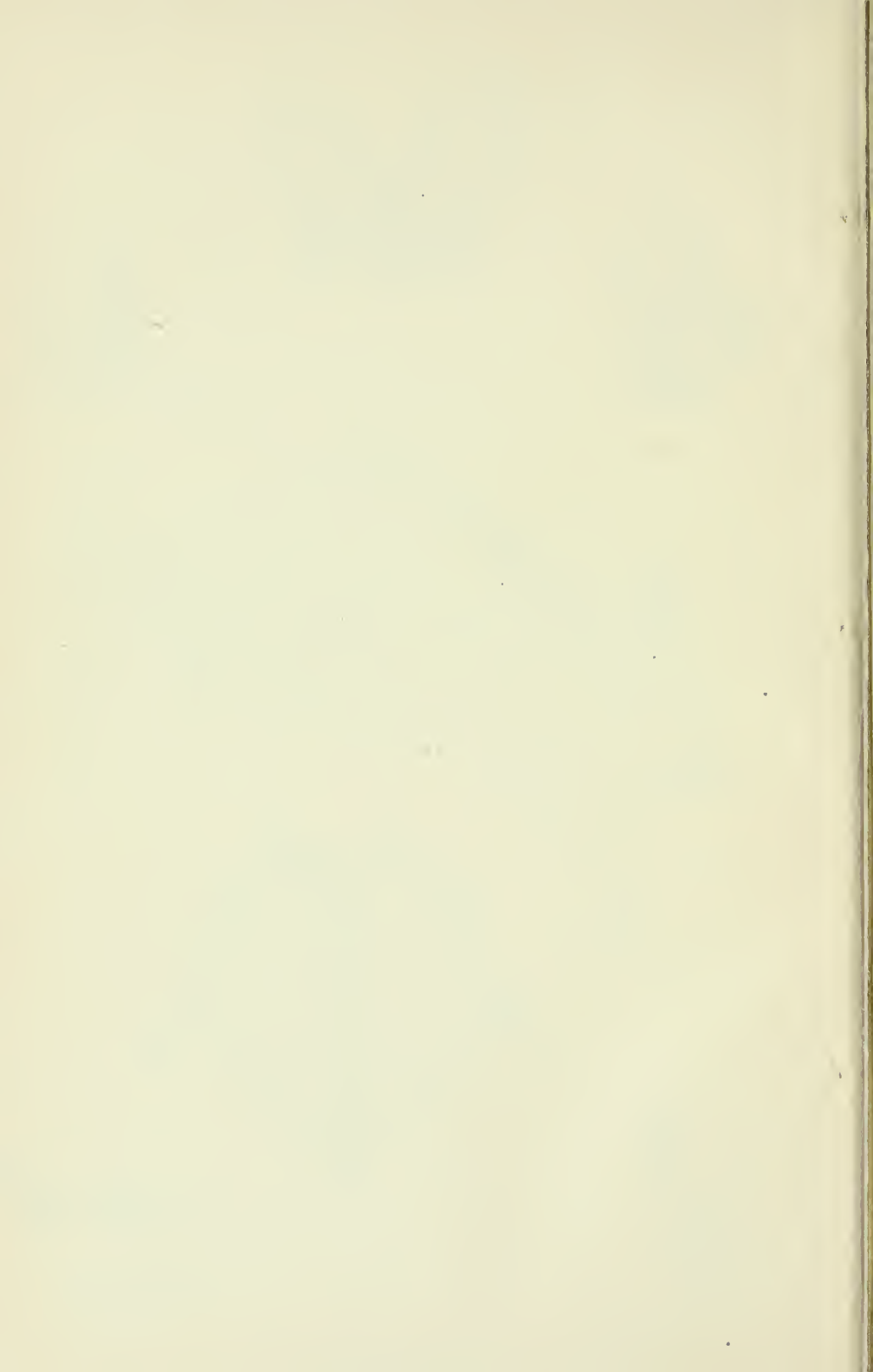
FIG. 5. Tail and interfemoral membrane.

FIG. 6. Skull seen from above. x 2.

FIG. 7. Skull seen from the side. x 2.



CORYNORHINUS MACROTIS.



without pit. A line produced from the upper border of the anterior nasal aperture intersects the junction of the first premolar with the first molar. The zygoma at the posterior third widened and elevated at the upper border. The paroccipital and mastoid processes are rudimentary, and the sterno-mastoid region is scarcely depressed. There is no trace of a sphenoidal tongue. The pterygoid process is conspicuous. The tympanic bone is complete and very large, concealing the cochlea. The tympanic bulla is in contact with the basioccipital and basisphenoid; it is not excavate, but incised anteriorly and barely reaches a line which answers to the posterior border of the glenoid cavity. The coronoid process is acuminate and about the height of the horizontal ramus. The posterior border of the ascending ramus is concave. The angle is produced but slightly beyond the condyle, and is deflected beyond the outer border as seen from above. The masseteric impression is imperfectly limited inferiorly, not reaching the border of the ramus. The angle touches the plane on which the mandible rests. The lower border of the ramus is markedly concave near the angle.

Habitat.—All the specimens examined have been collected in the South Atlantic States, except one from Santa Fé, New Mexico. On the authority of Prof. Baird, it has been obtained at Meadville, in northwestern Pennsylvania. At my request, Prof. J. H. Montgomery, of Alleghany College, Meadville, recently kindly collected a number of bats from this neighborhood, but has not succeeded in procuring *Corynorhinus*.

Measurements.

[No. 6062, from Mus. Comp. Zoöl.]

	Millimeters.
Head and body (from crown of head to base of tail).....	46
Length of arm:	
Length of forearm.....	38
First digit:	
Length of first metacarpal bone.....	3
Length of first phalanx.....	4
Second digit:	
Length of second metacarpal bone.....	32
Length of first phalanx.....	2
Third digit:	
Length of third metacarpal bone.....	35
Length of first phalanx.....	12
Length of second phalanx.....	17
Fourth digit:	
Length of fourth metacarpal bone.....	34
Length of first phalanx.....	9
Length of second phalanx.....	9
Fifth digit:	
Length of fifth metacarpal bone.....	34
Length of first phalanx.....	8
Length of second phalanx.....	8

	Millimeters.
Length of head:	
Height of ear.....	27
Height of tragus	12
Length of thigh.....	15
Length of tibia.....	19
Length of foot.....	10
Length of tail.....	44

Measurements from first edition of Monograph.

U. S. N. M. Cat. No.	From tip of nose to tail.	Length of tail.	Length of fore- arm.	Length of tibia.	Length of long- est fin- ger.	Length of thumb.	Height of ear.	Height of tragus.	Ex- pauze.	Nature of specimen.
	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	
5232.....	1.8	1.7	1.7	0.8	2.8	0.4	1.1	0.6	9.6	Alcoholic.
	1.8	1.7	(?)	0.8	2.6	0.4	1.1	0.6	9.4	Do.
1377.....	1.6	1.6	1.6	0.9	2.8	0.4	1.0	0.6	9.0	Dry.
4727.....	1.9	1.8	1.7	0.9	2.8	0.5	1.2	0.7	11.0	Do.
890.....	1.10	1.8	1.7	0.8	2.8	0.5	1.1	0.6	10.9	Do.

List of specimens.

Cat. No.	No. of speci- mens.	Locality.	Presented by.	Nature of speci- mens.	Collection.
5451.....	1	South Carolina	W. Cooper	Dry	U. S. Nat. Mus.
5526.....	1	do	do	do	Do.
5453.....	1	Society Hills, S. C.....	M. A. Curtis	do	Do.
5450.....	1	do	do	do	Do.
5452.....	1	Kemper County, Miss ..	D. C. Lloyd	do	Do.
5407.....	1	Eutaw, Ala.....	Prof. Winchell	Alcoholic	Do.
	1	(?)	(?)	Dry	Do.
5234.....	1	Micanopy, Fla.....	Dr. Bean	Alcoholic	Do.
4727.....	1	" United States	Maj. Leconte	Dry	Do.
5232.....	1	Santa Fe.....	W. J. Howard	Alcoholic	Do.

2. *Corynorhinus townsendii* (Cooper). (Plate VII).

Plecotus townsendii Cooper, Ann. Lyc. Nat. Hist. New York, IV, 1837, 73.

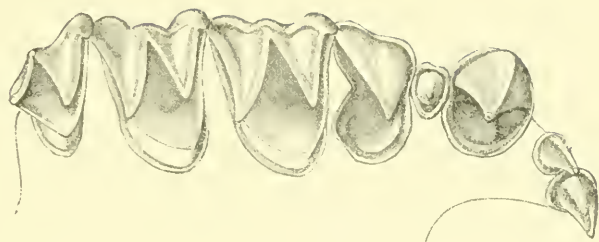
Synotus townsendii Wagner, Schreb. Säugeth. Suppl., v, 1855, 720.

Corynorhinus townsendii H. Allen, Proc. Acad. Nat. Sci. Phila., 1865, 173.

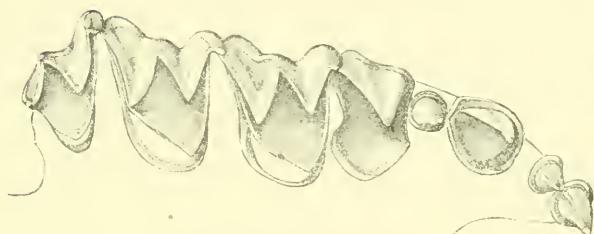
Plecotus macrotus Dobson, Cat. Chirop. Brit. Mus., 1878, 180; Allen, Monog. N. A. Bats, 1861, 65.

Diagnosis.—Post-digital nerve arises from near distal end of the fourth metacarpal bone. First phalanx of third and fourth digit shorter than second. The first phalanx, fifth finger, longer than second. Central maxillary incisor bifid. Forearm 38 to 40. Tragus slightly longer than in *C. macrotus*, and the general appearance of the animal is more robust. The fur quite as in *C. macrotus*, with the colors of ventre inclining more to gray than to white.

Maxillary teeth.—The maxillary incisors conical, simple, with entire, well-defined cingula; the inner border of the lateral not touching central. The central much the larger. The two teeth touching, but an interval present between the lateral and the canine. The first premolar minute; resembles lateral incisor. The second premolar with unusually trenchans protocone. The first molar with anterior commissure of protocone



1

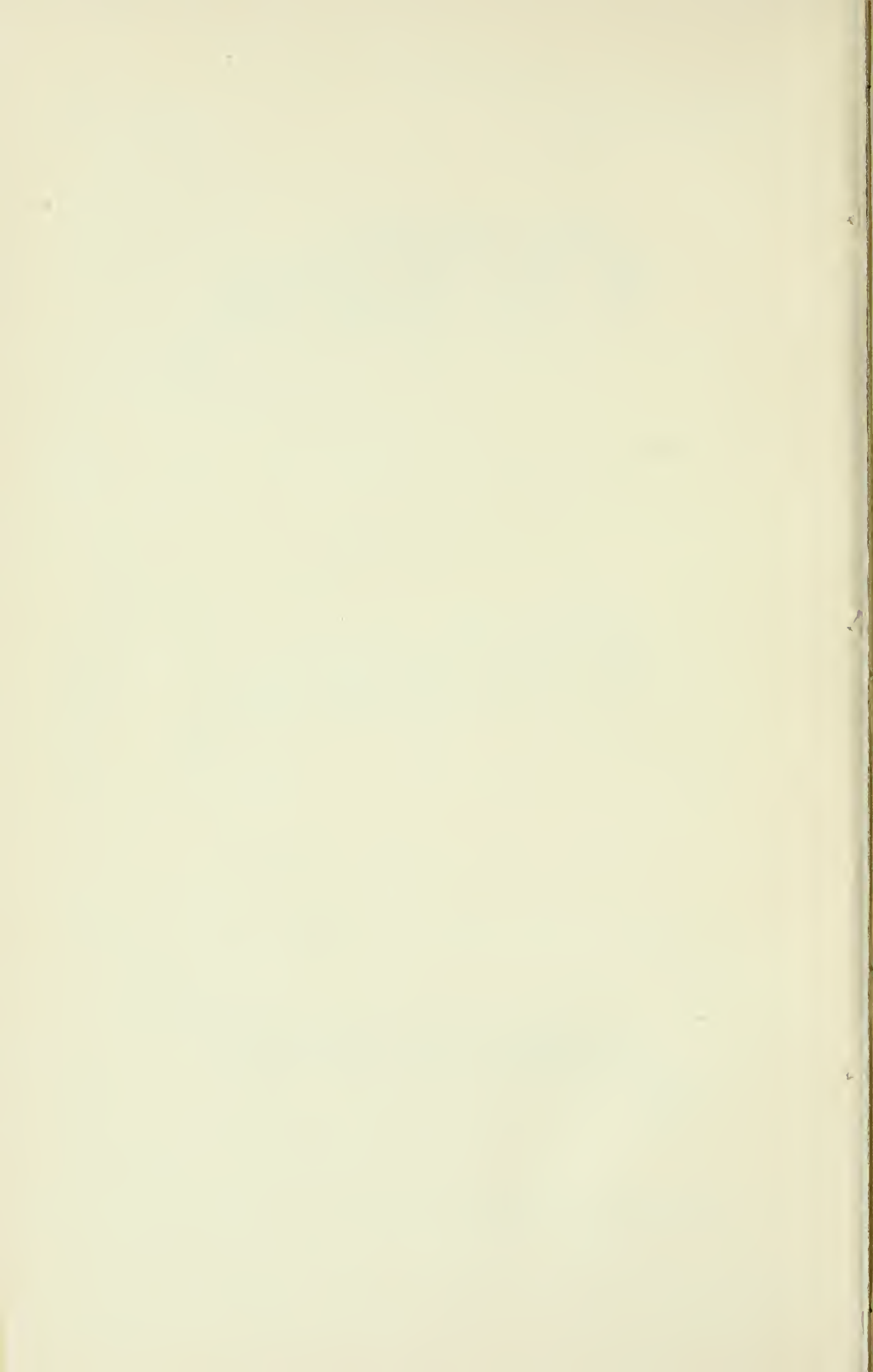


2



3

1. MAXILLARY TEETH OF *CORYNORHINUS MACROTIS*. X 12.
2, 3. MAXILLARY AND MANDIBULAR TEETH OF *CORYNORHINUS TOWNSENDII*. X 12.



trenchant and well seen from above. Anterior V slightly smaller than posterior; hypocone absent. The third molar with protocone with entire commissure; anterior V complete; posterior V lacking the greater part of the posterior limb.

Mandibular teeth.—The incisors trifid, scarcely crowded; basal ridge developed into a high cingulum, giving the teeth a multituberculate appearance. The canine with a well-developed cingulum at the lingual aspect; both anteriorly and posteriorly it is furnished with a tubercle. The first and second premolars are small, conical, with complete cingula. The first tooth is slightly the smaller. The cusps of the molars are all high and sharp. The heel is well developed in all the molars, and in the third is triangular. The commissure on base in all the molars is unusually high. The paraconid subequal through molars, inclined forward, the conjoined bases of this cusp and that of the metaconid incised somewhat as in *Macrotus*.

Notes on the skeleton—Scapula.—The coracoid is simple, neither curved backward nor forward; axillary border nearly straight, scarcely convex. *Humerus.*—The epitrochlea as in *Vespertilio*; the lateral groove on the trochlea is sharply defined; olecranon fossa present. *Ulna.*—Proximal rudiment anchylosed to radius; shaft not traceable. Distal rudiment quadrate plate as in *Vespertilio*. The pisiform bone lies across the palmar aspect of the carpus and does not act as a splint to the fifth metacarpal bone.

Habitat.—Western and central portions of the United States, extending south to Mexico.* Specimens in the National Museum are from Utah and the upper part of Missouri.

Measurements.

[No. 1226.]

	Millimeters.
Head and body (from crown of head to base of tail).....	38
Length of arm.....	21
Length of forearm.....	42
First digit :	
Length of first metacarpal bone.....	2½
Length of first phalanx.....	3½
Second digit :	
Length of second metacarpal bone.....	34
Length of first phalanx.....	2
Third digit :	
Length of third metacarpal bone.....	35
Length of first phalanx.....	13
Length of second phalanx.....	16
Fourth digit :	
Length of fourth metacarpal bone.....	
Length of first phalanx.....	10
Length of second phalanx.....	12

* J. A. Allen reports it from Guadalajara, Mexico.

Millimeters

Fifth digit :

Length of fifth metacarpal bone.....	16
Length of first phalanx.....	10
Length of second phalanx.....	9
Length of head.....	8
Height of ear.....	30
Height of tragus.....	13
Length of thigh.....	21
Length of tibia.....	9
Length of foot.....	37
Length of tail.....	

Measurements from first edition of Monograph.

Current number.	From tip of nose to tail.	Length of tail.	Length of forearm.	Length of tibia.	Length of longest finger.	Length of thumb.	Height of ear.	Height of tragus.	Ex. pause.	Nature of specimen.
	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	
5231.....	1.9	1.9	1.8	0.8	2.10	0.4	1.2	0.7	11.0	Alcoholic.
5230a.....	1.9	1.8	1.9	0.8	2.9	0.4	1.3	0.7	11.0	Do.
5230b.....	1.9	1.7	1.9	0.9	2.10	0.4	1.3	0.6	11.0	Do.
5230c.....	1.9	1.9	1.8	0.8	2.9	0.4	1.2	0.6	10.6	Do.
5230d.....	1.9	1.9	1.9	0.8	2.10	0.4	1.2	0.7	10.6	Do.
5230e.....	1.8½	1.9	1.8	0.8	2.11	0.4	1.2	0.6	10.0	Do.
5230f.....	1.9	1.9	1.9	0.9	2.11	0.4	1.3	0.7	10.0	Do.
5230g.....	1.9	1.8	1.8	0.8	2.10	0.4	1.2	0.6	10.6	Do.

List of specimens.

Cat. No.	No. of specimens.	Locality.	Presented by—	Nature of specimen.	Collection.
5231.....	1	Upper Missouri...	Dr. F. V. Hayden.....	Alcoholic.....	U. S. Nat. Mus.
5230.....	7	Utah.....	Capt. J. H. Simpson*	do.....	Do.

* Collected by C. S. McCarthy.

Genus **EUDERMA** H. Allen.*Euderma* H. Allen, Proc. Acad. Nat. Sci. Phila., 1892, 467.*Histiotes* J. A. Allen, Bull. Amer. Mus. Nat. Hist., III, No. 2, Feb. 20, 1891, 195.

Diagnosis.—Two premolars in each jaw. Auricle constricted at base, the simple internal and external basal ridges holding it to the corresponding borders of the base of tragus. The internal hem narrow, not over one sixth width of auricle. External basal lobe sharply defined posteriorly by the external basal ridge and is without ridge or lobule; post rictal wart absent. External basal lobe of tragus absent. Snout simple, broad median depression between nostrils. Membranes as in *Corynorhinus*. Auditory bulla not united on inner margin to skull, and reaches to a point opposite middle of glenoid cavity. General character of the teeth as in *Corynorhinus*.

Dental Formula.—Molars $\frac{3}{3}$; Premolars $\frac{2}{2}$; Canines $\frac{1}{1}$; Incisors $\frac{2}{3}$ $\times 2 = 34$ teeth.

The above diagnosis may be compared with advantage with that of *Corynorhinus* and *Plecotus*.

Corynorhinus.—Three premolars in lower jaw. Auricle not constricted at base; both basal ridges being free from tragus. Internal basal ridge with thick transverse fold simulating an internal basal lobe which is absent. Width of internal hem nearly half that of the auricle. Tragus with defined external basal lobe and notch. External basal lobe with internal lobule ending in large post rictal wart. Clavate process on each side of the snout; nostrils with raised border, lumen sinuate.

Plecotus.—Three premolars in each jaw. Auricle not constricted at base. The narrow internal auricular hem not over one-eighth width of the auricle and is produced inferiorly into a lappet. Internal basal ridge simple, free from tragus. External basal lobe not limited posteriorly and bears a minute lobule on inner surface. Tragus with well-defined notch and basal lobe; post rictal wart hairy, conjoined to basal lobe.

The following statements concerning the differential characters of *Euderma*, *Corynorhinus*, *Plecotus*, and *Synotis* are herewith submitted. In my judgment *Synotis* is more widely separated from the other three genera than are any of the last named from one another, and it is probably true that *Synotis* is not a member of the group of the plecotian bats, but is in closer affinity with *Vesperugo*.

Euderma.	Corynorhinus.	Plecotus.	Synotis.
Internal basal lobe free crossing internal ridge.	Internal basal lobe not free, rudimentary. Large swollen thread across internal ridge.	Internal basal lobe free, not crossing internal ridge.	No internal basal lobe.
Both internal and external ridges continuous with base of tragus.	Ridges not continuous with base of tragus.	Ridges not continuous with base of tragus.	Ridges not continuous with base of tragus.
Tragus without internal basal lobe.	Tragus with internal basal lobe.	Tragus with internal basal lobe.	Tragus with internal basal lobe.
Terminal cartilage, fourth digit axial.	Terminal cartilage fourth digit axial.	Terminal cartilage fourth digit axial.	Terminal cartilage fourth digit deflected toward thumb.
Coronoid process rounded; angle to lower jaw, broad at base.	Coronoid process acuminate; angle to lower jaw not broad at base.	.....	Angle of lower jaw narrow at base; coronoid process pointed.
Tympanic bulla extends forward to point opposite middle of glenoid cavity. Spheno-palatine foramen present; the upper orbital border rugose.	Tympanic bulla reaches posterior border of glenoid cavity. Spheno-palatine present; the upper orbital border not rugose.	Tympanic bulla reaches a point slightly in advance of the glenoid cavity. Spheno-palatine foramen apparently absent; Upper orbital border not rugose; trenchant.	Tympanic bulla reaches posterior border of glenoid cavity. Spheno-palatine foramen present; the upper orbital border not rugose.
Palatal plate extends back of line of last molar for a distance equalling nearly one-half the length of the pterygoid process.	Same .....	.....	Palatal plate extends back of line of last molar for a distance equalling one-third the length of pterygoid process.
Anterior temporal crest not marked.	Anterior temporal crest not marked.	Sagittal and anterior temporal crests marked.	Sagittal and anterior temporal crests marked.
Second upper premolar not touching first molar.	Second upper premolar not touching first molar.	Second upper premolar not touching first molar.	

1. *Euderma maculata* (J. A. Allen).

Histiotus maculatus J. A. Allen, Bull. Amer. Mus. Nat. Hist., 111, 1891.

Diagnosis.—The diagnosis of the single species is that of the genus.

Description.—Ears three-fourths length of the forearm, broad at tip, united by a small membrane. Internal basal lobe well defined. Inter-

nal basil ridge extends nearly the entire length of the auricle. External border simple, entire, without scallops. The external basal lobe well defined, simple, not recurved, hairy on outer surface. Auricle greatly constricted opposite base of tragus, to which it is attached: no external basal ridge. Tragus elongate, but scarcely narrowed at tip, little more than one-third the length of the auricle, straight or slightly convex on inner border, moderately convex on outer border; basal notch shallow, indeterminate; no basal lobe. Muzzle simple, depressed in middle; glands on the side rudimental, not club-shaped; nostril entire oval, without cornu.

The auricle is marked with numerous transverse striae at outer two-thirds excluding the tip. The inner border and tip fringed with short hair, a sparse growth occupies the inner surface of the auricle from the inner border of the internal basal ridge.

Membranes.—The thumb disposed to be flexed, the membrane extending to the base of the first phalanx. A distinct hem extends between the thumb and second digit. The second digital interspace 3^{mm} wide. Metacarpal bones distinct on palmar aspect. Palmar folds at fifth metacarpal two in number. The terminal cartilage of the fourth digit axial. Foot one-seventh of the length of the forearm. Tail as long the forearm, tip exsert.

The markings on the membranes are as follows: In the fourth interspace the predigital nerve arises midway along the fifth metacarpal and the post digital from the distal fourth of the fourth metacarpal bone. Oblique tibial lines four in number. The interfemoral membrane entire, ample, marked by ten well-defined complete transverse lines. Intercostals twelve in number, ranging obliquely outward and upward.

Fur.—Black and white hues arranged in a manner unique in Chiroptera. Dorsum with fur of a prevailing black, the hair being uniformly long and unicolored, excepting at the base of the ears, over the shoulder blades, and at the rump, where the hair is white. The clumps on the ear are unicolored; those on the shoulder blades have hair with basal half black; that on the rump is intermingled with black, but otherwise the hair is as on the shoulder blades. The nape of the neck, crown, and base of the ears, where they join the crown, of a more rusty black than that of the dorsum generally. This arrangement is limited by the low band which unites the ears; the face is sparsely covered with blackish hairs; the lips at the sides are whiskered; the spaces about the eyes are naked. The under surface of the body with white as its prevailing color, the basal portion of the fur everywhere being black, excepting where the large ear extends down on the side of the neck. In this region (viz the upper half of the neck) the hair is pure white and unicolored and continuous above with the basal ear clumps. The lower half of the side of neck is black throughout. A faint white line extends across the shoulder to unite the clumps on the shoulder blades to that of the ventre. The fur otherwise black at basal two-

thirds, apical third, white. The arm at its basal third black. The extent of the white portion diminishes from above downward. Membranes everywhere naked.

Skull.—Brain-case, low, quadrate, the height one-half the bimastoid diameter. The metencephalon as long as mesencephalon and proencephalon. Sagittal crest rudimentary, does not extend beyond a line answering to the middle of the zygoma, the remaining portions of the posterior temporal crest widely separated; the anterior not defined. Dorsum of face vertex with a shallow concavity which is not sharply defined; orbit with inflated inner wall and rugose elevated upper border; lachrymal tubercle marked. Infraorbital canal short; the foramen on line with interval between second premolar and first molar. Line of the upper margin of the anterior nasal aperture if produced would intersect the second premolar; tympanic bone apparently incomplete above.

The paroccipital process bold, trenchant; sterno-mastoid impression deeply concave; mastoid composed entirely of squamosal element. Zygoma quite as in *Corynorhinus*—the squamosal part twice as wide as maxillary; sphenopalatine foramen present, of large size. Occipital crest trenchant. Tympanic bone greatly inflated, equals one-third the length of the skull, not touching basioccipital, or basisphenoid; excavate anteriorly. It extends to a line which answers to the middle of the glenoid cavity. The mesopterygoid fossa as long as one-third the distance from the posterior palatal border to the incisors. The sphenoidal foramen is at the bottom of a deep recess. The coronoid process is round, small, raised scarcely one-third the height of the ascending ramus; lower border of the horizontal ramus near the angle slightly concave. The angle is raised from the plane on which the mandible rests. Atlas with large foramen for vertebral artery which rests on a mere thread of bone; transverse process semicircular without spine. In common with other cervical vertebrae the tubercle on anterior surface of body is marked. Ribs twelve in number. Both presternum and mesosternum keeled. Scapula much as in *Corynorhinus*. It was mutilated in the single specimen examined.

Maxillary teeth.—Incisors contiguous, slightly inclined toward the median line, but the lateral tooth separated from the canine by a moderate interval. Central incisor cuspidate with a small cuspule projected midway on the posterior surface; a distinct cuspule also arises from the cingulum posteriorly. Lateral incisor one-half the size of the central, and cuspidate, with a small cuspule arising from the cingulum on the anterior and a second on the posterior portion. Canine not larger than the second premolar, the buccal surface is abruptly convex. The first premolar is small not wedged in, with complete cingulum. The space between it and canine narrower than that between it and second premolar. The second premolar as long as the canine and slightly fluted, Molars as in *Corynorhinus*.

Mandibular teeth.—Incisors crowded, trifold, *i. e.*, the main cusp possesses a well developed cuspule on each side the base, the cingulum on the posterior side being large. The first and second teeth overlap for a distance equaling one-half of their diameters. The third incisor retains a posterior cuspule which is larger than the anterior and separated from the main cusp by a wide interval. The canine is small and projects but a slight degree above the incisors. It exhibits a marked cuspule on the cingulum anteriorly.

The premolars are separated by a small interval. The first is smaller than the second, distinctly trifold, and contiguous to the canine. The second is much larger and trihedral. The molars as in *Corynorhinus*; the apices of cusps acicular; the lingual surface of hypoconid is trifold.

Enderma is based upon the type specimen of *Histiotus maculatus*. Through the courtesy of Dr. J. A. Allen I have recently had an opportunity of examining it.

Dr. Allen believed that this striking form belonged to *Histiotus* on the ground that the shape of the ears and of the muzzle, as well as the disposition of the membranes, were of the same general type, while the teeth were the same in number. In my opinion these statements require modification. A minute first upper premolar is to be seen in the rather large space between the canine and the second premolar, thus separating Dr. Allen's species from *Histiotus*, in which a single upper premolar is present. Together with this peculiarity I find that the general characters of the skull, the teeth, and the wing membrane are like those of *Corynorhinus*. Indeed, it may be said to be a Plecotian genus without muzzle processes, and since with these peculiarities the new form possesses but two premolars in the lower jaw, it is quite distinct. I, therefore, propose to describe it as follows:

Habitat.—The single specimen known was collected by Mr. Thomas Shooter, Pirui, Ventura County, Cal. It was caught on a fence.

Genus **ANTROZOUS** H. Allen.

Antrozous H. Allen, Proc. Acad. Nat. Sci. Phila., 1862, 247; Monog. N. A. Bats, 1864, 66; Dobson, Cat. Chirop. Brit. Mus., 1878, 170; Coles and Yarrow, Wheeler's Exped., Zool., 1875.

Nose high, tapering, narrow; snout angular, blunt; nostrils apical, lower (outer) borders joining above in a transverse line; ears longer than head, not joined.

Dental Formula.—Molars $\frac{3}{3}$, premolars $\frac{1}{2}$, canines $\frac{1}{1}$, incisors $\frac{1}{2} \times 2 = 28$.

In the incomplete tympanic bone, in the absence of the palatal plate to the premaxilla, in the markings on the fourth digital interspace, in the shape and relations of the ulna, in the details of the molars, and in the arrangement of the nasal scrolls, *Antrozous* is in alliance with the Vespertilionidae. Affinity with *Corynorhinus* is suggested by the shape of the muzzle-glands. *Antrozous* resembles *Atalapha* in the shapes of

the last molars as well as in the proportions of the hypoconid. In the number and arrangement of the premolars and molars, as well as in the shape of the upper premolar, *Antrozous* is strikingly like *Dasypterus*. In the number of incisors in the lower jaw, in the free lower lip, in the manal formula, in the disposition for the nostril to bear a vertical internarial ridge and the upper border of the muzzle to exhibit a transverse outgrowth, in the presence of a hem on the pollical side of the second metacarpal bone, *Antrozous* recalls the Phyllostomidae.

In the restriction of the lower incisors to four in a family where the dominant number is six it is of interest to note that in *Nyctinomous brasiliensis* the third incisor on each side is rudimental or may be lost, thus reducing the number from six to four, the number normal to *N. macrotis* and *Promops*.

Peters has called attention to the affinity between *Antrozous* and *Nyctophilus*. I have lately been able to make a comparison between these genera, so far removed in geographical range. The following characters have not been used before in classification:

<i>Antrozous.</i>	<i>Nyctophilus.</i>
Transverse muzzle-band continuous with the lower margin of the nostril; thus the depression of the nostril is continuous with the groove above the nostril.	Transverse band is continuous with the upper margin of the nostril; thus the depression of the nostril is cut off from the pit above the nostril.
External basal lobe of the auricle without an inner fold.	External basal lobe of the auricle with a conspicuous inner fold.
Terminal cartilage of the fifth digit bifid, the somad lobe prolonged; inconspicuous accessory cartilage.	Terminal cartilage of the fifth digit acicular; conspicuous accessory cartilage.
The nerves in the fourth interdigital unequal, the post-digital much the longer.	The nerves of the fourth interdigital space of equal length and arise on same level.
Protocone small, not extending beyond the paracone.	Protocone large, extending entire length of tooth.
Upper premolar scarcely fluted, without cingulum on palatal surface. Lachrymal process small, no supraorbital ridge; facial vertex convex.	Upper premolar deeply fluted, with cingulum on palatal surface. Lachrymal process and supraorbital ridge trenchant; facial vertex flat or concave.

The shapes of the premolars and molars, the presence of the accessory cartilage to the fifth digit, the number of teeth in the lower jaw, are characters which ally *Nyctophilus* to the vespertilionines and place it near *Synotus*, while no characters suggest its affinity to the phyllostomines, unless the shape of the nose-leaf be held to be of this value. In common with *Corynorhinus* and *Antrozous*, the muzzle glands unite back of the nose-leaf. On the whole, I incline to the opinion that *Nyctophilus* did not arise from a stem distinct from that from which sprung the vespertilionines, while *Antrozous* arose from the phyllosto-

mines at a point not far remote from the vampyrine group, or the unknown ancestral stem of *Natalus* and *Thyroptera*.

1. *Antrozous pallidus* (Leconte). The pale bat. (Plates VIII, IX.)

Vespertilio pallidus Leconte, Proc. Acad. Nat. Sci. Phila. VII, 1855, 43; Baird, U. S. and Mex. Bound. Survey, Report II, 1858, Pl. I, Fig. 1.

Antrozous pallidus H. Allen l. c.; Dobson, Cat. Chirop. Brit. Mus., 1878, 170; Cones, Amer. Nat., 1867, 283; Cones and Yarrow, Wheeler's Exped., Zool., 1875, 85.

Diagnosis.—Scallops of auricle not breaking convex outline of outer margin; external basal lobe concealed in part. The vespertilionine tragus half the height of the auricle. Head folds continuous on the dorsum. Transverse ridge defines the upper border of the blunt muzzle. The nostrils simple, lunate. Chin plate subtriangular, defined. Incisors in lower jaw, four in number. Protocone rudimental; last maxillary molar but half the size of others and composed of rudimental protocone and paracone. Proximal rudiment of the ulna not ankylosed to radius at elbow. Muzzle glands flat, nearly confluent above. The second and third metacarpals distinct on palmar surfaces. Phalanges of the third digit of one length; the first phalanx of the fourth and fifth digit longer than the second. A well-defined hem of membrane is seen between the thumb and second digit; the fifth digit greatly longer than the forearm. The terminal cartilage of the fourth digit deflected toward the second digit. Numerous closely arranged muscle fibers arise from the tibia near the oblique tibial line and are dispersed over the greater part of the membrane nearly to the fifth digit.* The olecranon is dorsal, the membranes arising from the epicondyle. The second and third metacarpals are not on level of membrane, but raised above it, and not crossed by oblique lines. This easily distinguishes *Antrozous* from other genera of Vespertilionidæ.†

The manual formula is as follows:

Second interspace.....	3
Third interspace.....	15
Fourth interspace.....	28
Forearm.....	51

The greater part of the free margin of wing membrane with a delicate buff border. This is not peculiar, but appears to be unusually conspicuous.

The tail is raised from the plane of the undersurface of the interfemoral membrane near the pubis, but for the rest of its length it is raised from the dorsal. The terminal joint is exsert, and bears a small fleshy tip. The calcar is longer than the foot and ends in a small lobe. The post calcaral lobe is fleshy and obscurely defined. The interfemoral membrane is crossed by numerous broad transverse lines.

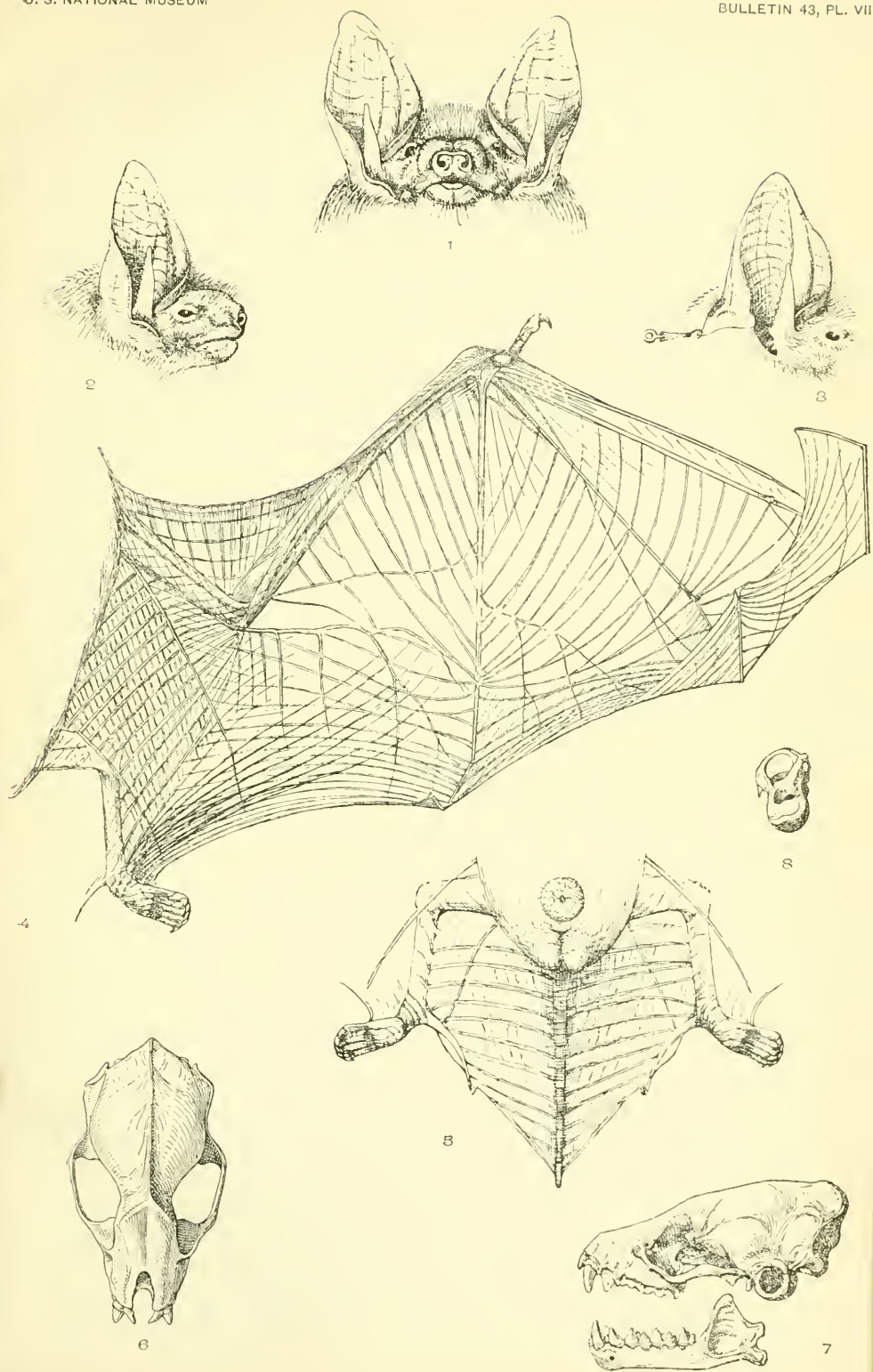
*The accessory cartilage must be sought for with care by the aid of a powerful lens.

†The statement of E. Coues that the second digit has two phalanges is not confirmed.

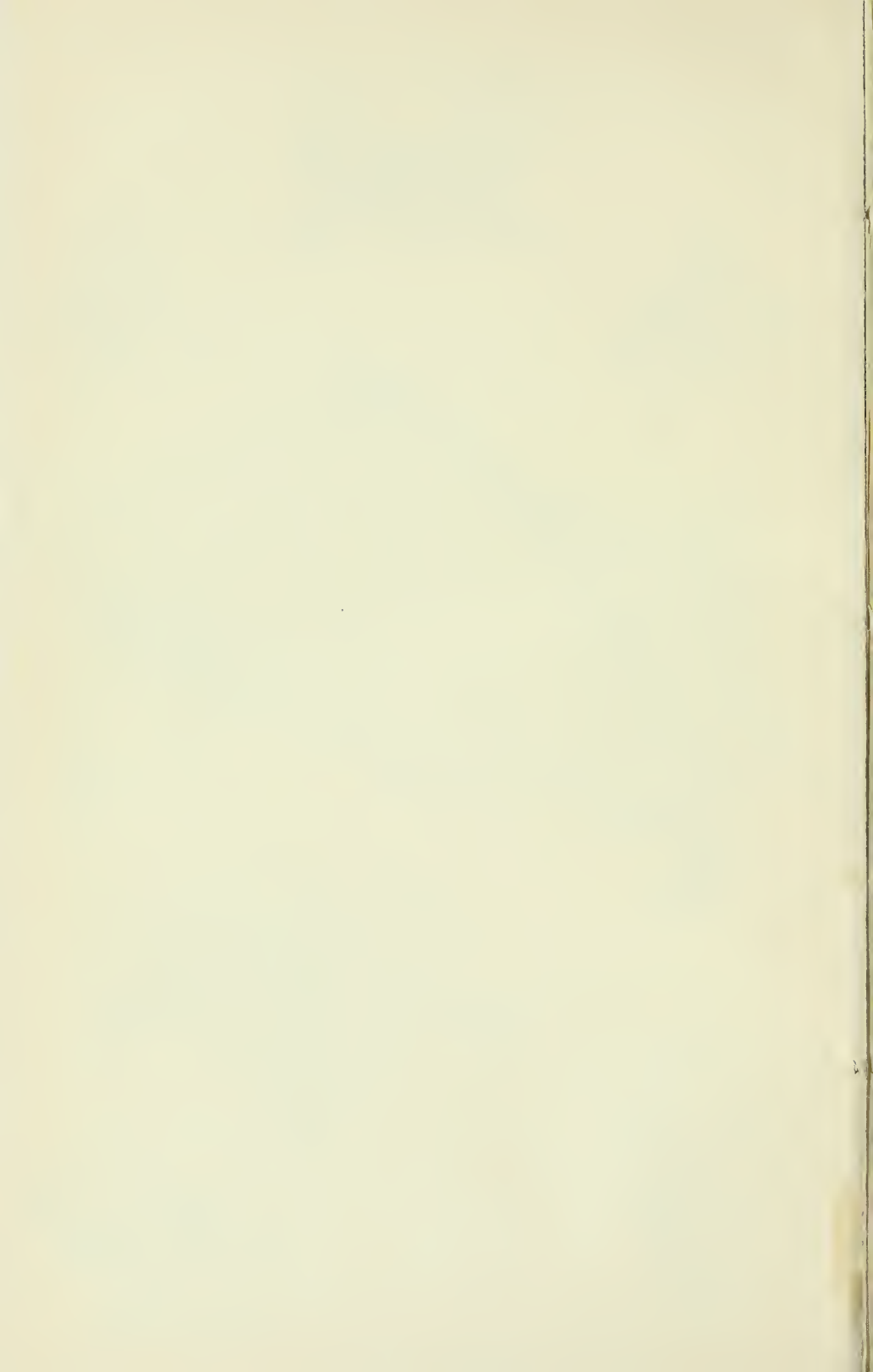


EXPLANATION OF PLATE VIII.

- FIG. 1. Front view of head of *Antrozous pallidus*.
FIG. 2. Side view of same.
FIG. 3. View of tragus and inner surface of auricle.
FIG. 4. Wing membrane.
FIG. 5. Tail and interfemoral membrane.
FIG. 6. Skull seen from above. x 2.
FIG. 7. Skull and lower jaw seen from the side. x 2.
FIG. 8. Os petrosa.



ANTROZOUS PALLIDUS.



The outer border of the ankle strengthened by a number of trabecular lines, which diverge in the endo partagium and intersect the lines passing between the humerus and the inferior extremity. Fascicles from coraco-brachialis and triceps muscles well developed. In the fourth interdigital space the predigital nerve appears at the distal third of the fifth metacarpal bone, while the postdigital appears from about the middle of the fourth metacarpal bone. Fascial bands marked at the base of the fifth digit.

Variations.—Two varieties of color are observed in this species—the fawn and the yellowish brown. The first was the one described by Maj. Leconte. This author says: "Hair light fawn colored, tip with darker, beneath paler." The yellowish brown may thus be described: Hair above light brown at base, darker at tips; below lighter brown not tipped. In some instances the brown tip above assumes a reddish tinge, and the fur beneath becomes almost white. The interfemoral membrane is entirely naked. At the base of the thumb a few brown hairs are found. The membrane to underside calcar in some individuals extends obliquely across to the hallical side of foot. As above stated the chin plate is often divided in middle line by a groove. An internarial vertical ridge is sometimes faintly defined. The nostrils are subject to slight variation in size of median part of aperture converting the lunate into an inverted comma-like figure.

Rugæ.—The folds seven in number. Between the second and the third, the third and the fourth, the fourth and the fifth, secondary crenulated folds appear.

Maxillary teeth.—The single maxillary incisor is simple, conical with a pointed basal cusp. Canine with posterior surface outside of axis of tooth row; palatal surface broad, marked by a longitudinal column which gives to it the appearance of a second cusp. The first molar with protocone raised slightly above the line of the small cingulum, the oblique anterior commissure being absent. An interval exists between the protocone and the posterior V. The anterior V is less than one-half the size of the posterior, both in vertical and bucco-palatal direction. The hypocone is absent. The second molar with protocone as in first molar. The anterior V is much larger than in tooth just named, but relatively smaller than in the corresponding teeth of other genera in the family. The third molar much as in *Atalapha*. The first limb of the anterior V alone marked; the protocone rudimental.

Mandibular teeth.—Incisors, trifold, not crowded. Canine with oblique cingulum on lingual aspect with no posterior tubercle. The first premolar obscurely bifid. First and second molars with thickened commissure to heel (hypoconid) encroaching on the grinding surface. The heel of the third molar a mere rudiment on lingual side.

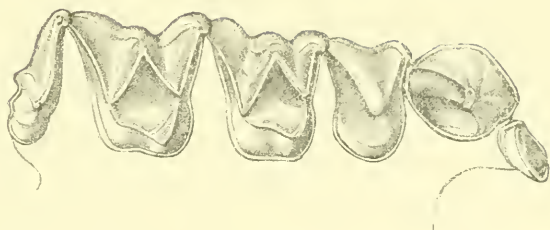
The paraconid and metaconid close together, and form a narrow base to the triangle formed by these elements and the protoconid. The hypoconid is much less developed than either of the other elements.

Skull.—The sagittal temporal crest is high and conspicuous over the mesencephalon and rudimentary over the metacephalon and proencephalon. A distinct convexity lies over the proencephalon. The anterior temporal crests are well defined. A tubercle lies at the basal end of each crest. From this tubercle forward the imperfectly defined upper border of the simple inner orbital wall extends. The vertex of the face is without nasal eminence; a groove extending from the beginning of the sagittal temporal crest to the anterior nasal aperture. The maxilla is without concavities. The anterior border of the vomer corresponds to the middle of the first maxillary molar. The nasal bones and the horizontal plates of the superior maxillæ advanced 2 millimeters beyond the vomer. Anterior nasal aperture incised. The inner wall of the orbit is convex. The lachrymal foramen is one-half as large as the infraorbital. The infra-orbital foramen relatively large and placed near orbit. The two parts of the tympanic bone do not unite but conceal the cochlea; the basisphenoid bone retains a nearly vertical auditory process. The mastoid is smaller than the paroccipital process. The sterno-mastoid impression is narrow, elongate, not inflated. The external semicircular canal is almost entirely, and the horizontal quite, covered with bone. The posterior and upper surfaces are as in *Atalapha*. The apertures in the cranium by which the otic capsules approach the periphery are circumscribed. The inner border of the condyle of the lower jaw is produced, acuminate. The masseteric impression is weak inferiorly; the angle is broad and flat, quite unlike other vespertilionine forms excepting perhaps *Harpiocephalus*. It lies in a line with the middle of the condyle and is therefore not deflected; the lower border of the fossa for the insertion of the temporal muscle forms a ridge which is continuous with the line of the alveolus. The ethmoid bone in this genus closely resembles that of other *Vesperilionidæ*. The ectoturbinal is compressed medio-laterally.

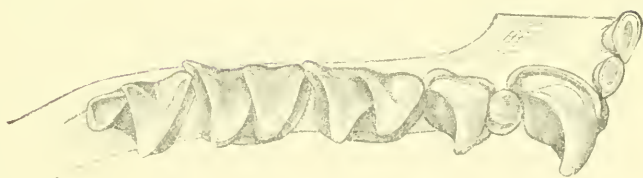
Notes on the skeleton.—*Scapula*: coracoid process turned forward at tip. Axillary border markedly convex below impression for triceps muscles. *Humerus*: epitrochlea projects horizontally, deflected downward, and is flat and broad; lateral trochlea weak, scarcely defined; no olecranon fossa. *Carpus* not distinctive: pisiform lies across palmar aspect.

Penis with a cauliflower-like thickening to prepuce.

Habitat.—The pale bat is found in California, Oregon, Cape St. Lucas, Mexico and Arizona. It is abundant at Fort Yuma. E. Cones states that it infests the houses and annoys the inmates by its scrambling about the recesses in the walls and copings. The naked muzzle has "a peculiar livid hue in life, rendering the animal more repulsive and forbidding than is usual even in this family."



1



2

1. MAXILLARY TEETH OF ANTROZOUS PALLIDUS. X 8.
2. MANDIBULAR TEETH OF SAME. X 8.

Measurements from an average of four specimens.

	Millimeters.
Head and body (from crown of head to base of tail)	48
Length of arm	31
Length of forearm	51
First digit:	
Length of first metacarpal bone	3½
Length of first phalanx	5
Second digit:	
Length of second metacarpal bone	39
Length of first phalanx	2½
Third digit:	
Length of third metacarpal bone	43
Length of first phalanx	13
Length of second phalanx	13
Fourth digit:	
Length of fourth metacarpal bone	43
Length of first phalanx	12
Length of second phalanx	11
Fifth digit:	
Length of fifth metacarpal bone	43
Length of first phalanx	11
Length of second phalanx	8
Length of head	23
Height of ear	26
Height of tragus	
Length of thigh	17
Length of tibia	19
Length of foot	11
Length of tail	41

Measurements from first edition of Monograph.

Current number.	From tip of nose to tail.	Length of tail.	Length of forearm.	Length of tibia.	Length of longest finger.	Length of thumb.	Height of ear.	Height of tragus.	Ex-pause.	Nature of specimen.
	In.	In.	In.	In.	In.	In.	In.	In.	In.	
152	2.10	2.0	2.0	0.9	3.0	0.4	0.10	0.6	12.0	Dry.
538	2.0	(?)	2.0	0.8	3.0	0.5	0.9	0.5	10.6	Do.
521	2.4	(?)	1.10	0.8	3.0	0.5	0.10	0.5	11.0	Do.
889		1.6	2.0	0.9	3.4	0.5	1.0	0.4	11.0	Do.
887	(?)	(?)	2.0	0.9	3.0	0.5	0.10	(?)	(?)	Do.
431	2.6	(?)	2.0	0.9	3.4	0.5	0.10	0.6	11.6	Do.
85	2.0	1.6	1.11	1.0	3.0	0.4	0.10	0.6	11.0	Do.
173	2.0	1.6	2.0	1.0	3.0	0.5	0.12	0.7	11.2	Do.
	2.4	1.6	2.0	0.10	3.4	0.5	1.1	0.7	11.6	Do.
45	2.5	1.9	2.0	0.9	3.5	0.5	1.0	0.7	12.0	Do.

List of specimens.

Cat. No.	No. of specimen.	Locality.	Presented by—	Nature of specimen.
152	1	El Paso (Boundary Survey)	J. H. Clark (type)	Dry.
5241	1	San Elizario, Tex.	Dr. C. B. Kennerly	Alcoholic.
5240	1	Fort Bliss, N. Mex.	Dr. S. W. Crawford	Do.
5455	1	Fort Dalles, Oreg.	Dr. Geo. Suckley	Dry.
538	1	Posa Creek, Cal.	Dr. A. L. Heermann	Do.
521	1	Tejon Valley	do	Do.
5238	1	Fort Tejon, Cal.	John Xantus	Alcoholic.
5237	5	do	do	Do.
5239	4	Fort Yuma, Cal.	Maj. G. H. Thomas	Do.
5236	19	Cape St. Lucas	John Xantus	Do.

While the sheets were passing through the press the following additions have been made to my study of *Antrozous* and its allies, *Dasypterus*, *Corynorhinus*, and *Nyctophilus*. In *Antrozous* the paraconids and metaconids are indistinctly defined and much crowded; in *Dasypterus* they are well defined and separated from each other, as is the case in the family. *Antrozous* differs from *Dasypterus* in the presence of a broad, flange-like epicondyle; in the simple (nonbifid) coracoid process; in the smaller pisiform bone, which shows no disposition to be prolonged downward along the shaft of the fifth metacarpal bone; in the fifth metacarpal bone being almost the length of the fourth; in the greater trochanter being broad, and not deflected backward; and in the outer femoral condyle being smaller than the inner. The first phalanx, respectively, of the second, third, fourth, and fifth toes are disposed to be dorsiflexed on the metatarsus—a character apt to be repeated in all scurrying forms. I say apt to be repeated, for it is an adaptive character and due to muscle traction. The reader is referred to the figure of *Adelonycteris fuscus* in illustration of the shape taken by the toes when the animal lies prone. This position is sometimes also assumed in specimens preserved in strong alcohol. The absence of such a disposition in *Corynorhinus* and *Dasypterus* is in consonance with other characters, namely, that in these genera the foot is adapted to hanging rather than to scurrying, and that both genera are of the broad-winged parachuted type of flight rather than of the narrower-winged zigzag-flying type. One notes, therefore, without surprise that the third finger, both in *Corynorhinus* and *Dasypterus*, is longer than in *Antrozous*.

In *Nyctophilus* it is seen that the inner condyle of the femur is smaller, and the greater trochanter is deflected backward—the last character especially being best developed in parachuted types.

The union of gland clumps back of the nose-leaf in *Antrozous* is in evidence of a disposition seen in *Brachyphylla* and *Phyllonycteris*. So far as it goes, it indicates an approximation of the genus to the phyllostomines.

Peters (SB. Akad. Berlin, 1882, 987) places *Antrozous* and *Nyctophilus* in association with *Rhinophylla* and *Megaderma* (!). It is remarkable that *Macrotus* should also have been placed in a similar alliance. (See this genus.) I have had no means of instituting comparisons with either of the forms last named.

Genus **VESPERTILIO** Linnaeus.

Dental formula.—Molars $\frac{3}{3}$, premolars $\frac{3}{3}$, canines $\frac{1}{1}$, incisors $\frac{2}{3} \times 2 = 48$ teeth.

The genus *Vespertilio* will be restricted to those bats which, having on each side of the jaw three premolars and three molars, have in addition two upper and three lower incisors. Each species possesses an erect, tapering tragus and a marginal external basal lobe to the auricle.

Both the internal and external basal lobes are near together and form the lower end of an ellipse of which the tip constitutes the upper end. In contrast with *Kerivoula* and *Natalus* the scallops come well forward in front of the conch. Both sides of the auricle in good specimens are usually marked with raised arborescent lines. In further contrast with *Kerivoula* and *Natalus* (genera which have the same number of teeth as *Vespertilio*) a phalanx is present in the second manual digit. The third digit is scarcely longer than the combined lengths of the body and the lower extremity, while an oblique tibial line is present on the wing membrane. The scallops of the auricle are membranous (*i. e.*, not thickened), and are not incurved toward the tragus in the manner which is so conspicuously the case in *Adelonycteris* (*q. v.*). The protocone of the third upper premolar is well defined. The post-digital nerve of the fourth interspace arises from the side of the fourth metacarpal bone near the middle.*

The exact relations which obtain between *Adelonycteris*, *Vesperugo* and the older genus *Vespertilio*, have not been determined. This arises from the fact that minute variations in the numbers of teeth in bats appear to be less denotive of structural peculiarities elsewhere in the economy that is the case with the mammalia generally. Dobson (*l. c.*) places *Adelonycteris*, *Vesperugo* and *Lasionycteris* in the same group, each being the type of a sub-genus. But the intervals between members of the group are most unequal. *Adelonycteris* and *Vesperugo* can scarcely be separated except by the teeth while *Lasionycteris* has distinguishing characters in many parts of the periphery.

While the species of *Vespertilio* are exceedingly variable, it is of interest to note that the wings are quite constant in form. Scarcely any distinctions are discernible between these parts in species so remote in areas of distribution as those of Europe and America. The shape of the tragus is of more exact specific value than the wings and on the whole yields the best single character of the skin surface. The interfemoral membrane is variable and is of much less value than the tragus in denoting the constancy of species. The same may be said of the auricle, for its shape and proportions are more generic than specific in significance, though it must be conceded that the size of the first scallop and the character of the outer border above the scallop distinguish varieties. At best the American species are less sharply distinguished from one another than are those of the old world. In support of this statement the ensuing notes are presented of my observations on a few well-known exotic forms:

V. muricola (India).—Nostril with cornu well defined with prominent margins, border of nostril at muzzle imperfectly limited, septum recedent obscure. Muzzle

* *Vespertilio*, according to Coates and Yarrow (Wheeler Expedition, 1875), includes all bats with $\begin{smallmatrix} 1 & 2 & 2 & 3 \\ 2, & 2, & 3, & 3, \end{smallmatrix}$ premolars. These characters define respectively the genera (as defined by them) *Vesperus*, *Vesperugo*, *Vesperides*, and *Vespertilio*.

glands distinct, nodular. Postmental wart constitutes a large, hard nodule. Thumb directed outward, scarcely larger than its metacarpal bone; callosity large.

V. nattereri (Europe).—Nostril as in *V. muricola*; muzzle and post mental glands rudimental. Internal margin of the auricle and internal basal lobe not lying against the head. Outer margin of the base of the tragus obscurely separated from the inconspicuous lobule. Tragus greatly produced, filiform. First metacarpal bone strongly flexed, outline defined; callosity small. Thumb scarcely if at all projected beyond the contour of the second metacarpal bone. Oblique tibial line arises from the distal third of the tibia.

V. capaccinii (Europe).—Feet enormous; tragus long, filiform; membrane from ankle, or a point slightly above it, covered with hair which also clothes the leg and the sides of the interfemoral membrane.

V. mystacinus (Europe).—As opposed to the preceding this species is not so easily distinguished from the American species (vide Monograph). The tragus is quite as in the phases of our Western States. The fur presents some distinctive features, viz, in the different hues of brown of the back.

The American species further resembles *V. mystacinus* in the bearded upper lip, especially the western forms, as stated in Monograph, p. 60. In alcoholic specimens this is less conspicuous than in the dry, for the hairs are soft and readily cling to the skin. In some varieties the hairs quite thickly clothe the sides and front of the face, and are conspicuous from their black color. Apart from the wing membrane this is the best peripheral character by which *Vespertilio* can be distinguished from *Adelonycteris* and *Vesperugo*.

The difficulties acknowledged in identifying the American species are apparently insuperable, so great is the range of variation in the proportions of the ears, thumb, feet, tail, and phalanges of the manus, and in the coloration of the fur and the membranes. If the purposes of zoölogical science should end with the identification of species, the student might well be discouraged in his studies in this field. But fortunately the very intricacies of the subject suggest problems, in the attempts to solve which, his knowledge of the life and structure of these little organisms can not fail to be increased.

After careful consideration from the available material, I have concluded that there are three species of *Vespertilio* in the United States, namely, *V. gryphus*, inhabiting the country east of the ninety-eighth degree parallel longitude; *V. albescens*, and *V. nitidus*, in the country west of the line above named.

Numerous variations exist which make it unsatisfactory to frame diagnoses of these species after the manner seen elsewhere in this memoir. Such variations are of great interest, and it will be found convenient to retain for them names of well-marked varieties as though they had specific value. Among such I include *V. lucifugus* under *V. gryphus*; *V. melanorhinus* under *V. albescens*; *V. macropus* under *V. albescens*; *V. erotis* under *V. albescens*; *V. longierus* under *V. nitidus*; *V. yumanensis* under *V. nitidus*.

Variations in animals are commonly included under the headings of the regions of country in which they occur and by which their distribution is limited. While varieties so defined are doubtless the main

ones, two other kinds are recognized as present in the American species of *Vespertilio*. The first of these is ontogenetic and consists in adults not infrequently retaining in an irregular manner some of the proportions of the young. This I propose calling pedomorphic variation, or pedomorphism. The second is due to depositions of black pigment in increased proportion in those parts of the skin which is not covered by fur, as on the ears, membranes, snout, and feet. This I propose calling melanic variation. Pedomorphic and melanic variation is seen in all three species.

I propose presenting each of these subjects in some detail under distinct headings, as follows:

Pedomorphic variation.—In young bats the foot and thumb are apt to be disproportionately large as compared with the same parts in mature individuals; at the same time the auricle and tragus are correspondingly small, the snout high, blunt, and nearly naked. This disposition for our species occasionally to retain juvenile peculiarities has led to much confusion in their identification. Prof. E. D. Cope has proposed to employ for this condition the term retardation, that is to say, the parts above named are, as it were, held back while others are permitted to go on to adult expression. *V. lucifugus* of Leconte is a pedomorphic variety of *V. gryphus* as *V. yumanensis* is a similar variety of *V. nitidus*.

It is easily understood how necessary it is to determine the age of a given specimen to be identified, since an immature form of the typical example of a species may be similar to the fully grown adult from the retardation of development in the characters above named. In quite young individuals the fourth and fifth digits are of the same length while the basi-occipital bone is not coössified with the sphenoid, and the epiphysis at the distal end of the metacarpal bone, as well as both ends of the humerus, are detachable. In older specimens, yet immature, the proportions of the manus are as in the adult while the joint last named is still without sharpness of outline, thus indicating imperfection in development. The interfemoral membrane is triangular, the tip of the tail boldly exerted, and the post calcareal lobe is absent. The teeth are fully erupted long before the tail and the manus are complete, so that the characters presented by them are of little value in determining age after the animals become independent food-seekers. The study of the young, therefore, is of importance in the identification of species. Mr. J. A. Allen (Mammals of Massachusetts) has stated that in his judgment *V. lucifugus* is the young of *V. subulatus*, a statement which is equivalent to saying that bats having the characteristics above developed are always immature. I have, therefore, taken pains to examine carefully the composition of the bones in the forms which I have included in the monograph under *V. lucifugus*, and I can definitely assert that they are not immature. With the exception of the characteristic retention in the head, foot, thumb, and interfemoral mem-

brane, the proportion of the wings and the details of the skeleton and of the teeth are precisely those of *V. gryphus*.

The pedomorphic varieties of *V. gryphus* appear to be more common in cold, elevated countries than in warmer. The retardation may be due to the environment being unfavorable to development, owing to a short summer and a correspondingly long period of hibernation. This, however, is a surmise, as excellent examples are met with in *V. albescens* along the southern parts of California and in Lower California. The markings of the membranes in pedomorphism are precisely those of the typical adults. The characters which may be retarded are, of course, infinite. In point of fact, however, those which are usually found associated are those above named. Occasionally a small ear and tragus is found with a small foot and large interfemoral membrane. The opposite to this I have not seen, namely, a large foot with a large ear, tragus, and interfemoral membrane.

Melanic variation.—When the pigmentation is everywhere so great as to give a black hue to the membranes, ears, face, and feet, the contrast is so great between the individuals and those which exhibit the translucent black shades as to be very noticeable. Since the intensely black forms include those which also possess auricles which are moderately or scarcely concave on the outer border, and which are larger than the head, they constitute true varieties. *V. evotis* and *V. melanorhinus* are melanic varieties of *V. albescens*. *V. longicus* True is probably a melanic variety of *V. nitidus*. Melanic variation is less common in *V. gryphus* than in either of the western species. In no instance does it enter into a diagnosis. Black varieties through the fauna may be found in both the typical and the pedomorphic adults.

It is difficult to determine the examples of *Vespertilio* from the country west of the ninety-eighth parallel. The change of color of fur and membrane, the variation in the shapes of the interfemoral membrane, the relative lengths of the limbs, especially of the thumb, feet, and legs, are unavailable for purposes of diagnosis.

I assume that the following characters determine the western species: Lateral upper incisor much less frequently crenulated at cingulum than in the eastern forms, and disposed to inward rotation. Penis small, with narrow, often pigmented prepuce. Fur forming a transverse white line under the lower jaw. Tragus not isosoles, but straight on inner border and convex at lower part of the outer border. If the outer border is without concavity above this convex portion, then the tragus is semielliptical; if the border is with concavity, then the tragus is semipyramidal. The membranes are translucent, never brown in tint, but when not melanic are of a peculiar blueish-black, gray tinge. Reinesque describes a species of North American *Vespertilio* under the name of *V. cyanopterus*, which I have been unable to identify. (See Appendix.) The "wings are of a dark blueish gray." The difference between a dark bluish gray and a diluted translucent black is, perhaps,

one of personal equation. To express it differently, the membranes are lightly pigmented, though the pigment is black in color. The anterior surface of the interfemoral membrane appears to be less pigmented than other portions of the wing membranes. As a result the membrane presents a whitish appearance, as though a little chalk and water had been lightly painted over it. The post calcaral lobe is often well developed, but on the whole is inconstant.

The characters of the eastern species are seen in the diagnosis and description of *V. gryphus*, and are in contrast to the western.

The distribution of the genus *Vespertilio* in North America is similar to that of other genera of mammals whose range is extensive. Thus it can be said that the western forms in the United States (west of 98°) are distinct from the eastern; that the eastern forms range north and northwest through British America with little variation, and that they are disposed to reappear in the mountain ranges of the northwestern United States along the Pacific coast, presumably by migration from the north along paths of high altitude; that the southern parts of the eastern United States, say from below 36° latitude, resemble Mexican phases, as do those of the western, from an irregular line between 36° and 42° latitude.

The species of the genus, therefore, are the least local of any members of the fauna. It is probably true that all of its representatives have been derived from one or more tropical ancestors, and that an exhaustive knowledge of these forms will be required before the peculiarities of the more northern phases can be properly interpreted. Assuming that migrations have taken place from the south to the north, the lines of their first divergence would appear to have occurred in the northern parts of Mexico in three separate trends—one to the northeast through the Gulf States; one due north through Arizona and New Mexico, and one northwest through the Sacramento Valley. At points farther north the lines become greatly disturbed, the tropical features are to a great extent lost, and the study of individuals becomes one of great intricacy. Greatly extended research beyond the means available to the writer will be needed before the questions of distribution and the validity of zoölogical varieties can be determined. The conclusions at present thought to be tenable may serve a useful purpose until the question can be settled by students who are more favorably situated than he.

1. *Vespertilio gryphus* Fr. Cuvier. The little Brown Bat. (Plates X, XI.)

Vespertilio gryphus Fr. Cuvier, Nouv. Annal. du Museum, Paris, 1832, 15.

Vespertilio salerii, ibid.

Vespertilio subflavus, ibid.

Vespertilio caroli Temminck Monog. Mam. II, 1835, 237. Wagner, Schreb. Säugeth.,

Suppl., v, 1855, 749; Dobson, Cat. Chirop. Brit. Mus., 1878, 325.

Vespertilio domesticus Green, Cal. Nat. Hist., II, 290.

V. subulatus Harlan, Fauna Americana, 1825, 22 (not Say); Richardson, Fauna Boreal. Amer., 1, 1829, 3; Godman, Amer. Nat. Hist., 1, 1831, 71; Cooper, Ann. Lyc. N. Y., iv, 1837, 61; De Kay, Nat. Hist. N. Y. (Zool.), 1842, 8; Wagner, Schreb. Säugeth. v, 1855, 750, Leconte, Proc. Acad. Nat. Sci. Phila., 1855, 436; H. Allen, Monog. N. A. Bats, 1864, 51; Dobson, Cat. Chirop. Brit. Mus. 1878, 324.

As indicated by the synonymy, this bat is the same as the *V. subulatus* of the first edition of the Monograph.

Maj. Leconte rehabilitated *V. subulatus*, Say, (see Appendix), and subsequent writers accepted this writer's determination. The type is lost. The original diagnosis was remarkable in four respects: It described the lower canine as bifid on one side—an anomaly I have never seen; it was drawn up from an immature individual; it was of a dull cinereous color on the dorsum, and had hairs on the free border of the inter-femoral membrane. The specimen was secured on the Charles River, one of the sources of the Arkansas, in a section now near Pueblo in southwestern Colorado.

The only specimens of *Vespertilio* which have been described from regions near the one described are *V. nitidus macropus*, nob., which was obtained from Fort Whipple, Ariz., and *V. nitidus ciliolabrum*, Merriam, which was collected in western Kansas.

In one of the four specimens of *V. nitidus macropus* in my possession the color of the fur might easily be said to have a grayish cast, though the predominant color is brown. The question at once arises, can a specimen of *Vespertilio* collected in southwestern Colorado on the eastern slope of the Rocky Mountains be said justly to be the same as those which frequent the Eastern and Gulf States? I believe this question must be answered negatively, so long as I hold to my present opinion that western and eastern forms are distinct. It is agreed that the ninety-eighth parallel represents the line which separates the two sections, and since Charles River lies well within the western section, there appears to be no longer a doubt that *V. subulatus* is western in its affinities. Since the description of Say, therefore, can not apply, it is necessary to determine which of the numerous names given to the eastern form is available.

The diagnoses of Fr. Cuvier (*l. e.*) might all apply—three of them to the Northern (*V. gryphus*, *V. salarii*, and *V. crassus*) and three to the Southern varieties (*V. erecks*, *V. georgianus*, and *V. subflavus*). *V. georgianus* was sent to Cuvier by Maj. Leconte and the name was accepted by the donor of the specimen as applicable to the form described in this memoir under the name *Vesperugo carolinensis*. Of the remaining species it would appear to be appropriate to select the first in the order of the description. If this plan be accepted *Vespertilio gryphus*, Fr. Cuvier, is the name of the eastern species. The term "murinoid" of this writer happily gives the reader a clue to the affinity of the species, since *Vespertilio murinus* of Europe resembles our species of *Vespertilio* in many respects. The presence of two additional molars in the upper jaw as contrasted with the number in *V. erecks* the "serotinoid" bat *i. e.*



EXPLANATION OF PLATE X.

- FIG. 1. Front view of head of *Vespertilio gryphus*.
FIG. 2. Side view of same.
FIG. 3. View of tragus and inner surface of auricle.
FIG. 4. Wing membrane.
FIG. 5. Tail and interfemoral membrane.
FIG. 6. Skull seen from above. x 2.
FIG. 7. Skull and lower jaw seen from the side. x 2.
FIG. 5. Maxillary incisors. x 32.



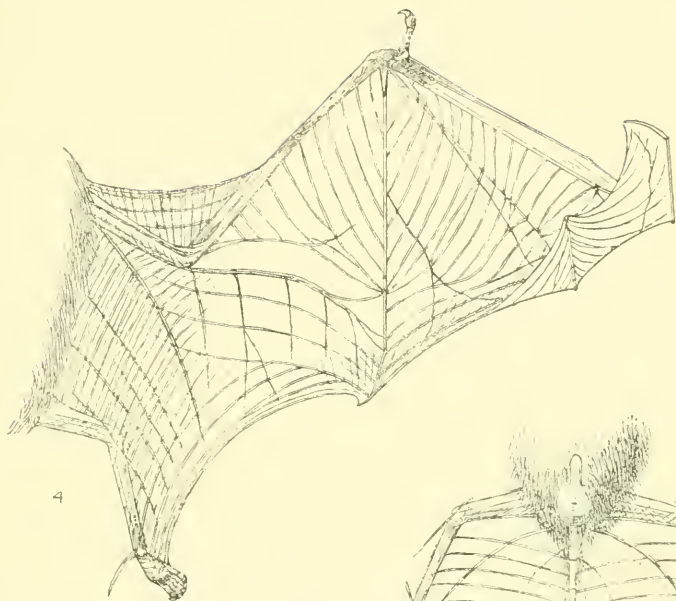
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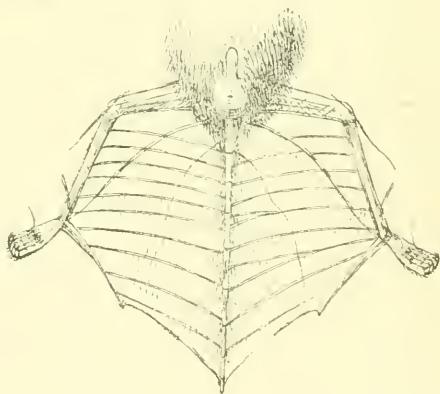
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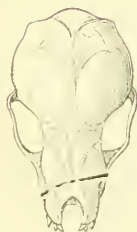
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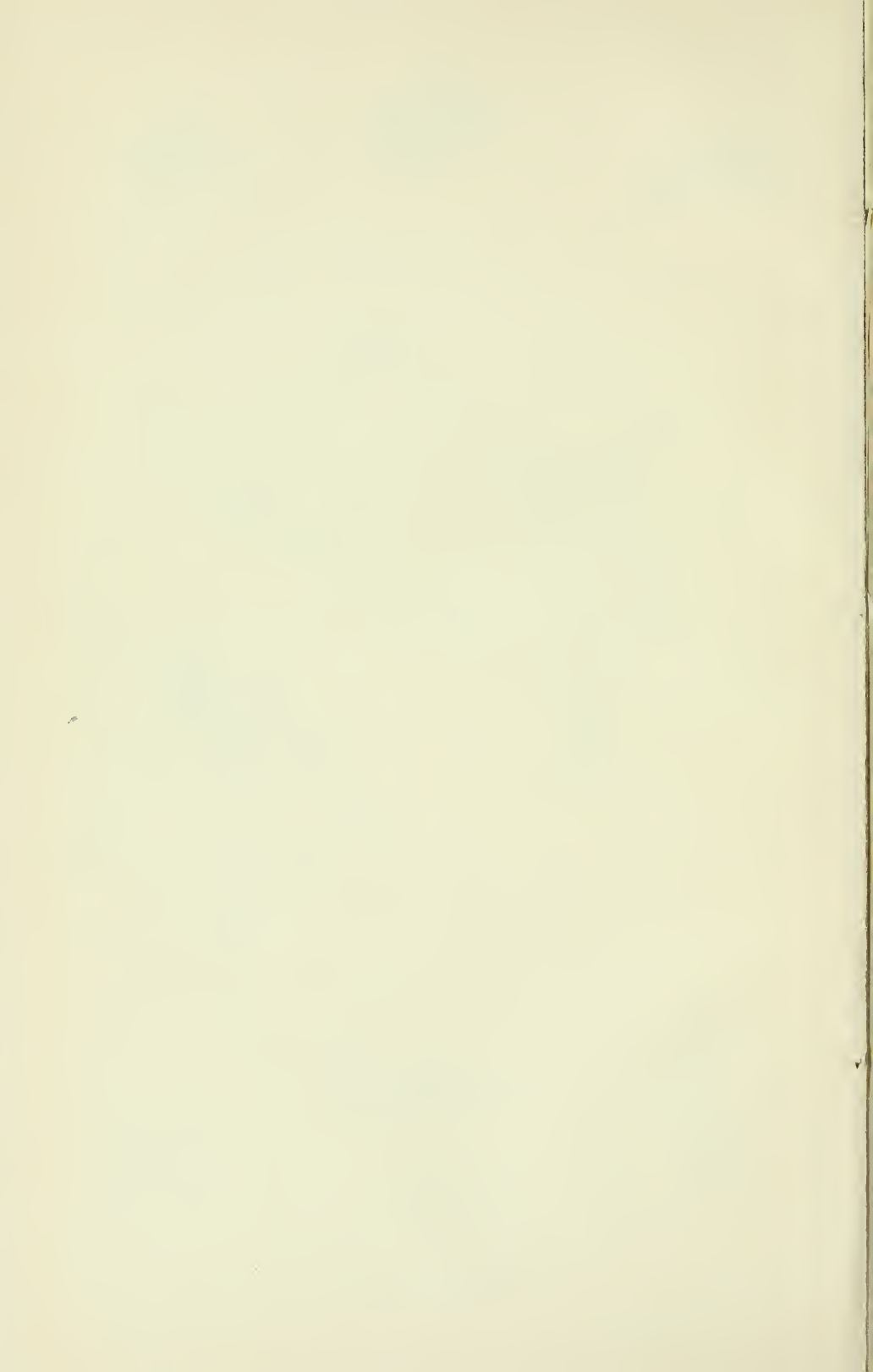


7



8

VESPERTILIO GRYPHUS.



a *Vesperugo* or an *Adelonycteris*, which have "no false molars above and but one below" is in direct testimony that this writer treated the last premolar as a molar and the smaller premolars as "false molars." The language implies the same as the modern expression that there are two minute premolars in each jaw in the *Vespertilio* and but one minute premolar in the lower jaw of *Adelonycteris*.

The following embraces the salient points in Temminck's account of the coloration in *V. caroli*: "Jones, côtés du cou et toutes les parties supérieures d'un brune-roussâtre à base des poils noire; en dessous d'un blanc jaunâtre à la pointe et brun-foncé à la base."

Diagnosis.—Subacuminate, tapering ears. Interfemoral membrane below the level of the ankles triangular; tip of tail exsert; penis large, with distinctly expanded but concealed glans; prepuce never pigmented. Lateral maxillary incisor disposed to outward rotation, almost always with crenulated cingulum. The face broad, from 9^m to 10^m between the ears, and, owing to the presence of large muzzle-glands, giving the region in front of the eyes a swollen appearance. A supralabial groove not distinctly inclines toward the mouth anteriorly; gape of mouth rarely extends back beyond the internal canthus. The tragus is slender and pointed; the inner border is straight, with the outer border inclined outward, thus forming two sides of an isosceles triangle. Above the notch the tragus is falciform and turned outward. It is rarely crenulate on the outer border. Membranes incline to be brown above (never black excepting in the lucifugan variety) and gray with tawny shades below. The hair on the dorsum of the interfemoral membranes ends abruptly at the level of the knees. Manual formula variable. The following are expressions of it:

First interspace	} 1
Second interspace	} 2½
Third interspace	} 8
Forearm	} 11
First interspace	} 23
Second interspace	} 23
Third interspace	} 35
Forearm	} 35

Description.—The auricle is elongated, with slightly acuminate internal basal lobe, and moderately convex anterior border and rounded tip. The external border directly below the tip and for a short distance is emarginate. The first scallop is distinct; the second indistinct, and the ridges are scarcely developed. The external basal lobe is rounded, small, incurved as a rule, thickened, and broader than high. The internal and external basal lobes lie near together, while the two borders of the auricle lie far apart. Hence the form of the ear is that of an oval, the lower external part being concealed by hair. Both sides of the auricle in well-preserved examples are marked by numerous raised arborescent lines; no transverse plicæ, such as are often conspicuous in the ears of bats, are here, as a rule, noticeable.

The tragus is acuminate, the anterior border straight, the external

oblique, the widest part of the tragus being just above the small semicircular notch; the external basal lobe with a disposition to turn inward, *i. e.*, toward the interior of the auricle.

The sides of the muzzle with well-developed glands, which give the face a swollen appearance. The chin is provided with a triangular naked space whose apex is often slightly prolonged; the nostril with nearly central septum, and separated from the mouth by the width of the labial border only.

The wing membrane extends to the base of the toes; the tip of the tail is moderately exsert. The postcalcaral lobe slightly developed or absent.

The fur of the back is of a prevalent dark brown or olive brown color; basal third, plumbeous black. The brown color is apt to be somewhat lighter on the head and base of the ears than elsewhere. It varies in character, being sometimes dark brown and often light, or shades with admixture of russet, yellow, and even of gray. The basal two-thirds may be smoky brown instead of dark plumbeous. The under surface of the body is of a light gray, verging to tawny shades; the basal two-thirds of the hair is black. The skin from chin to a point as far back as the oral angles scarcely lighter in color than the rest of the body.

The melanic variety of *V. gryphus* is much less common than with *V. nitidus* or *V. albescens*. A good example of it is seen in a specimen in the United States Department of Agriculture (No. 23276, from Cherokee, N. C.). The dorsal brown is of so deep a hue in this example as to appear black in alcohol.

The variations of *V. gryphus* are two in number, as follows: (*a*) The pedomorphic forms (See p. 73), examples of which can be found in any of the geographical varieties and find their best expression in the *V. lucifugus* of Leconte; (*b*) a geographical variety confined to northern parts of the United States and Canada, and not embraced in other groups.

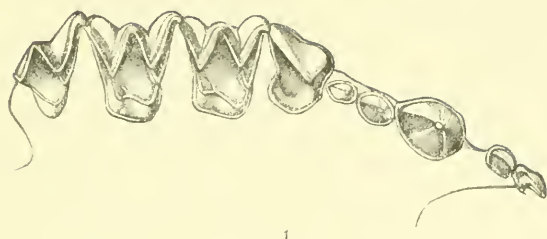
Var. (*a*)—*Vespertilio gryphus lucifugus* (Leconte).

V. lucifugus Leconte, Cuv. An. Kingdom (McMurtrie's ed.), I App. 1831, 431; *Ibid*, Proc. Acad. Nat. Sci. Phila., 1855, 436; Dobson, Cat. Chiropt. Brit. Mus., 1879, 328; Alston, Biol. Centrali-Amer., Mam., 1879-'82, 25.

V. crassus Fr. Cuv., Nouv. Annales du Museum d'Hist. Nat., 1832, 15.

V. brevirostris Max. Prince von Wied, Verzeich. Beobach. Säugeth. N. A., 1860, 19.

Description.—Head rather large, somewhat flattish; lips moderately whiskered; snout more obtuse than in other varieties of *Vespertilio*; nostrils sublateral, some distance from free border of upper lip; ears narrow, blunt at tip, slightly emarginated on outer side—the internal basal lobe produced, rounded, and somewhat obtuse, not thicker than other portions of ear. Tragus half as high as auricle, mostly blunt, unfrequently abruptly acuminate. Mental space well defined. Feet large; inter-



1



2

1. MAXILLARY TEETH OF *VESPERTILIO GRYPHUS*. X 12.
2. MANDIBULAR TEETH OF SAME. X 12.

femoral membrane of moderate size; termination of calcar with inter-femoral somewhat abrupt; the point of tail exerted.

Coloration subject to little variation, that of the back dark plumbeous at base, with dark or lightish olive-brown tips; that of the belly lighter at tip—exhibiting a whitish gray or yellowish gray appearance. The color is thus similar to that of *V. gryphus*.

The narrow blunt ear, short face, and the elevation of the nostril above the free margin of upper lip are the characters which serve to distinguish this subspecies.

V. daubentonii, of Europe, bears some resemblance to this subspecies in the shape of the ear and tragus; but it is dissimilar in the whitish color of fur beneath, and in the attachment of the wing membrane to foot, which is here joined to the ankle instead of the base of the toes as in *V. gryphus lucifugus*.

The specimen, numbered 5538, from the east of Colville, Northwest Territory, has a pointed tragus, and the middle part of the free border of the interfemoral membrane fringed with stiff hairs. The fur of the body is silvery beneath, blackish above, back of feet not hairy. Another form from St. Louis, Mo. (Cat. No. 5344), has the wing membrane attached to the ankles—the foot being entirely free. In other respects both agree with *V. gryphus lucifugus*.

I have thought it necessary to thus briefly indicate these two aberrant individuals, without giving any separate account of them. Should future collections bring forward any others having the same peculiarities as the above.

Measurements from first edition of Monograph.

Current number.	From tip of nose to tail.	Length of tail.	Length of forearm.	Length of tibia.	Length of longest finger.	Length of thumb.	Height of ear.	Height of tragus.	Expanse.	Nature of specimen.
	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	
5336	1.10	1.5	1.5	0.7	2.6	0.2 $\frac{1}{2}$	0.6	0.2	9.0	Alcoholic.
	1.9	1.5	-----	0.6 $\frac{1}{2}$	2.4	0.2 $\frac{1}{2}$	0.6	0.3	8.6	Do.
5353	1.9	1.6	1.4	0.4	2.5	0.3	0.7	0.3	8.0	Do.
5347	1.9	1.6	1.4	0.4 $\frac{1}{2}$	2.5	0.3	0.6 $\frac{1}{2}$	0.3	8.9	Do.
5376	1.9	1.6	1.4	0.4	2.5	0.3	0.7	0.3	8.9	Do.
5401	2.0	1.6	1.7	0.8	2.6	0.3	0.7	0.4	10.0	Do.
5364	1.6	1.3	1.3	0.6	2.3	0.3	0.6	0.3 $\frac{1}{2}$	8.0	Do.
5377	1.9	1.3	1.3	0.7	2.2	0.2 $\frac{1}{2}$	0.6	0.3	9.0	Do.

List of specimens.

Cat. No.	No. of specimens.	Locality.	Presented by	Nature of specimens.	Collection.
5376	1	James Bay, Hudson's Bay	C. Buxler.....	Alcoholic.	U. S. Nat. Mus.
5335	1	Westport, N. Y.....	S. F. Baird.....	do	Do.
5334	2	do	do	do	Do.
5336	3	Foxburg, Pa.....	do	do	Do.
5338	1	Washington, D. C.....	do	do	Do.
5337	2	do	C. Gerard.....	do	Do.
7197	1	Beaufort, S. C.....	Dr. Hayden.....	do	Do.
7198	1	do	do	do	Do.
5319	1	Isle Royale, Lake Superior.	B. A. Hoopes.....	do	Do.
5354	1	Detroit River.....	S. F. Baird.....	do	Do.
5501	1	Grosse Isle, Mich.....	Rev. C. Fox.....	Dry.	Do.
5500	1	do	do	do	Do.
5505	1	do	do	do	Do.
5373	1	Wisconsin.....	A. C. Barry.....	Alcoholic.	Do.
5498	1	Racine, Wis.....	Dr. P. R. Hoy.....	Dry.	Do.
5349	5	Cook County, Ill.....	R. Kennicott.....	Alcoholic.	Do.
5497	1	do	do	Dry.	Do.
5347	2	Cairo, Ill.....	do	Alcoholic.	Do.
5363	1	Fort Pierre, Nebr.....	Dr. Hayden.....	do	Do.
5379	1	Santa Fé, N. M.....	W. J. Howard.....	do	Do.
5374	2	Cantonment Burgwyn, N. N	Dr. Anderson.....	do	Do.
5361	5	Puget Sound, Wash.....	A. Campbell.....	do	Do.
5366	3	do	Dr. Suckley.....	do	Do.
5378	2	Fort Steilacoom, Wash.....	do	do	Do.
5299	1	Columbia River.....	United States Exploring Expedition.	do	Do.
5403	2	Fort Reading, Cal.....	Dr. J. F. Hammond.....	do	Do.
5364	2	do	do	do	Do.
5383	2	Cape Flattery, Wash.....	Lieut. Trowbridge.....	do	Do.
5380	1	(?)	(?)	do	Do.
5377	1	(?)	(?)	do	Do.
5373	1	Aspinwall, N. G.....	Dr. S. Hays.....	do	Do.

In this connection it may be said that J. B. Tyrrell (*l. c.*) has collected this from as far north as the Hudson Bay. 4961, M. C. Z. from Arkansas is the most southern locality from which I have noticed it. The foot in this specimen is very large, viz., 1^m long; the base of toes are furnished with long hairs, the tibia is 17^{mm} long, and the external basal lobe of the auricle is not incurved.

Var. (*b*) Northern form of *Vespertilio gryphus*.

It is highly probable that this variety has been repeatedly described in numerous accounts of North American bats (see Appendix) but for the reasons already given it is impossible to determine to which species of the earlier naturalists it should be assigned. It is found best expressed in the region of which the St. Lawrence River is the center. Specimens have not been found north of Canada, south of New York, nor west of Wisconsin.

The tragus is long (truly subulate) directly outward. The anterior border of the auricle is distinctly convex, the posterior border concave. Ears long, next to *V. albescentis evotis* in size. They reach beyond the median line at mentum. The foot is small, scarcely one-third the length of tibia. No post-calcaral lobe, but an apici-calcaral lobe is well marked; the tip of the tail is exsert; the membranes are light-brown in color.

List of specimens.

Cal. No.	No. of specimen.	Locality.	Collection.
5385	1	Nova Scotia	U. S. Nat. Mus.
5386	1	do	Do.
6320	1	Halifax, Nova Scotia	Do.
7253	1	do	Do.
8188	1	do	Do.
11820	1	Baysfield, Wis	Do.
	1	Woods Holl, Mass	Do.
5334	1	West Point, N. Y	Do.

Two specimens of bats have been examined from the far north. One of these is No. 11160 N. M., Rupert House, Hudson Bay. Immature. The fur is dark brown. The tragus is small. The other is No. 11189 N. M., Alaska. The ear is large, the tragus is subulate, and the proportions generally quite as in the southern forms. The fur is dark brown. The specimen is in very poor condition. It is placed provisionally with *V. gryphus*. It is nearer the gryphian than the nitidian forms, but can not be included in any of the above varieties. The ease with which the bats from British America can descend along lines of high elevation into the northwestern part of the United States renders it probably true that a mingling here of eastern and western forms take place. At all events I find it sometimes impossible to identify many specimens collected in Alaska, the western coast of British America, western Washington, and Oregon.

A specimen which I have recently received from Dr. Merriam, obtained from Princess Charlotte Islands, belongs to the same category.

Membranes.—The predigital nerve in the fourth interspace appears from the side of the fifth metacarpal bone at about its middle and is larger than a postdigital opposite which it appears at the side of the fourth metacarpal. The transverse lines in the interfemoral membrane are nearer to each other near the base than elsewhere.

The muscular mass of the base of the fifth metacarpal bone (composed of the *flexor minimi digiti* and the *interosseous*) equals one-sixth the length of the bone. The metacarpal bones more distinctly defined on the dorsum than venter; the ventral aspect of the fourth metacarpal bone is the least distinct of any, owing to the fact that it is crossed by numerous minute fibers.

Maxillary teeth.—The maxillary central incisor caniniform, slightly larger than the lateral, and (owing to a high degree of development of the cingulum) is marked bifid at cutting edge. The lateral border of palatal surface with a basal cusp. Lateral incisor with a main conical crown, which is somewhat wavy in contour posteriorly. Cingulum low and broad on the posterior and lateral borders, but crenulated and disposed obliquely forward and upward to the median border of the tooth, nearly reaching the level of the main cusp-tip. The variable

oblique cingule band constitutes a marked peculiarity of this and allied species. Both the central and lateral incisor are disposed to be turned on themselves. The central presents its labial surface obliquely toward the median line (see Pl. X, fig. 8); the lateral at a right angle, or, early so, to the central. The degree attained by this rotation constitutes the difference between the divergence of the parallel alignment of the main cusps. These peculiarities, according to Dobson, present characters which are of value in distinguishing species. But they appear to have no validity in American examples of *Vespertilio*.

Canine with a well-developed concavity on palatal surface, but without any on the posterior surface. Its anterior surface is trenchantly fluted near median border. Of the three premolars the first two are small, conical with well-defined cingula, the first with the larger. The second is usually in tooth line, but may lie back of it, and therefore not be seen from without. Molars have two supplemental lines extending from the commissure of the protocone to the apices of the subequal Vs. Rudiment of a heel is plainly discernible. The third molar with a rudiment of a posterior limb.

Mandibular teeth.—The first and second incisors crowded-trifid. The third massive, square, or rugged, due to irregular development of the cingulum, which nearly reaches the level of the obscurely trifid edge. Canine with well-defined posterior and lingual surfaces. The first and second premolars small, conical; the first the larger, the second sometimes thrown in a little of the axis of the series. The molars as in *Adelonycteris* and *Vesperugo*; the heel of the third molar with small, acute cusp. The cusps, seen from lingual aspect of the lower molars, sharp and well developed. The hypoconid slightly larger than the triangle composed of the protoconid, paraconid, and metaconid. The cingulum forms a little cusp on the posterior border of each molar.

Dental variations.—In a specimen from the mouth of the Colorado River (No. 11170, N. M.), the maxillary lateral incisor on both sides was much larger than the small unicuspid central; the last line of the second V of the third molar was absent.

In the main modifications are noted in the relation of the superior premolars and in the shapes of the superior lateral incisors. The premolars may be crowded so that the second is often not visible from without and even the first may be placed so far inside the line of the other teeth as to be scarcely seen. Both Dobson and Merriam accept this disposition as of specific significance. I can not concur. In examples of both *V. gryphus* and *V. nitidus* I find examples of this recession.*

The cingulum of the lateral incisor may be entire or lacking on median contour; the median flange may be crenulated or smooth; the palatal

* Dobson describes this arrangement as characteristic of *V. albesceus*, and Merriam of *V. ciliolabrum*.

base may be wide or greatly restricted. After a careful search I remain of the opinion that the differences in the form of this unique tooth are not of specific significance.*

In the teeth of individuals in whom the teeth are worn it is impossible to note distinctions in the relation of these teeth.

Skull.—The skull is nearly flat. The mesencephalon measures 3^{mm}. The length of the skull is 14^{mm} to 14½^{mm}. The greatest width is 8^{mm}, and the least width, viz., at proencephalon, is 4^{mm}.† The posterior impression of the temporal muscle is barely visible. A small sagittal line is seen over the mesencephalon, but no elevation anywhere. The proencephalon is seen at the vertex and is convex on the side. The vertex of the face with a linear groove which extends almost to the anterior nasal aperture. The fronto-maxillary inflation is rudimental and confined to the upper border of the orbit and does not involve the lachrymal region; no tubercle is present over the foramina. The lachrymal foramen is large and placed well in advance of the orbital foramen of the infra-orbital canal. The inner wall of the orbit is faintly convex. The infra-orbital canal is not defined inferiorly and the depression lies in a space between the eminence for the third premolar. The paroccipital process is produced as a spine, nearly as long as the occipital condyle, and projects below the level of the mastoid. The coronoid process is higher than the horizontal ramus. The masseter impression is brought well down nearly to the lower border of the horizontal ramus. The angle is produced, slender, and reaches slightly beyond the condyle. It is deflected so as to lie to the outer side thereof. A minute posterior spine is seen at the symphysis.

The following specimens exhibit some individual variations in the skull. The brain case is markedly elevated above the face. Greatest width, 7^{mm}; least width, 4^{mm}. A distinct tubercle overlies the orbital foramina.

M. 6072 N. M. The linear groove not quite reaching the anterior nasal aperture. The temporal impressions are well defined, leaving a convex triangle at the occiput. The upper border of the orbit is rather trenchant, no tubercle is present.

Pedomorphic forms from Georgia, M. 4380-2 N. M. A tubercle lies over the orbital foramina; a linear groove reaches the anterior nasal aperture; the sphenoidal tongue does not reach the tympanic bone.

The turbinals exhibit the following features: The encranial surface in all essential features as in *Adelonycteris*. The single ectoturbinal one-

*This little tooth can not be seen to advantage unless studied as a microscopic object. It is exceedingly difficult to draw. Mr. von Irtson has done the best possible. At my request Prof. Henry F. Osborn carefully examined this tooth. I hoped that he might recognize in it characters in common with those of the teeth to the extinct forms of micro-mammalia; but he assures me that nothing similar to it has been seen by him in his special studies in this group.

†In *V. nitidus ciliolabrum* the greatest width is 6^{mm}, the least width, 4^{mm}.

third the length of the first endoturbinal plate. As seen from above, the ectoturbinal is lodged in a concavity in the lateral surface of the preceding plate. The first endoturbinal is produced as far as the first premolar. The plate is of a pyriform figure as seen from above, and presents a truncate apex. The portion in advance of the transverse lamina is deeply concave below and overlies the maxilloturbinal. The second endoturbinal is of a triangular figure with a rounded apex. It appears to be lodged, when the parts are viewed superficially, on the median surface of the endoturbinal series. The third endoturbinal is the smallest of the three, and is continuous with the upper portion of the first endoturbinal.

Notes on the skeleton.—Atlas with two depressions in front. Scapula. Superior vertebral angle on level with base of the coracoid, the end of which is simple, not tapering. Humerus with trochlea axial, epicondyle small, nodular, and placed in front of a deep fossa. Radius much compressed laterally. The central articular groove at proximal end narrow but deep, the median flange semicircular and without facet in front. Proximal rudiment of ulna filiform, free;* distal rudiment a perforate quadrate plate. Of the proximal ends of the metacarpal bones, the fourth has the least motion and presents a deeply excavated proximal surface; the fifth has most motion and presents a flat proximal surface. The third is slightly deflected toward the center of the manus. The third, fourth, and fifth metacarpal bones diminish slightly in length in the order of the bones named. Occasionally the fourth is slightly shorter than the fifth.

Habitat.—*V. gryphus* appears to be an abundant species in the northern and northeastern range of the United States and in the Mississippi Valley as far west as the ninety-eighth degree of longitude, but less abundant in the Middle and South Atlantic States. I have never collected it near Philadelphia. According to J. B. Tyrrell it is found in Canada east of the Rocky Mountains. The vespertilionine bats from northwestern British America and Alaska are of this species, modified, possibly, by breeding with northern forms of *V. albesceus*. At least I can not otherwise determine them. See in this connection remarks, p. —. Pedomorphic varieties straggle as far north as Hudson Bay. It appears to be a strictly pastoral species,† and is found aggregated in large numbers in caves in association with *Adelonycteris fuscus*, *N. humeralis*, and *V. carolinensis*. It is frequently mistaken for the species last named. Sometimes it is found clinging together in clumps under the bark of decayed tree trunks.

*The study of the proximal end of the ulna must be made by dissection. The bones as usually prepared show none of the characters. The ulna ends "free"; that is to say, lies as a filament among the muscles of the forearm.

†The word "pastoral" is here used in contrast to "urban." It is not collected in houses either in town or country, but in trees and in caves.

V. gryphus bears a close resemblance to *V. albescens*. The proportions in the main are the same. The thumb is of the same size in the two forms. The differences which obtain between the two species in the direction of the supralabial groove and the shape of the tragus are perhaps as trenchant as any. The region at which the species are collected appear to strengthen the contrasts; thus, the *V. albescens* of southern California are easily distinguished from the *V. subulatus* of New England and Canada, while the Texan examples are more difficult to determine. It is likely that the species is primarily tropical, and in its subsequent movements to the north it underwent modifications, one variety following the western northern and great plateau, and preserving most of the peculiarities of the type. Another variety follows the eastern path and ranges over the lower countries east and north of the Mississippi River. In Texas the two have scarcely separated. Material is wanting to prove the difference which may exist between the forms between eastern and western Texas. From the difference in altitude between the coastwise lands of the east and the plateau lands of the west variations in *Vespertilio* of the kind indicated might be expected to exist.

I have not been successful in detecting secondary sexual characters in *V. gryphus*. Little is known of the characters of the young (*i. e.*, with milk dentition) of this species. The fur of the venter is paler and more yellow than in the adult. While the postscapular lobe is almost absent, the metacarpal bones are relatively short and of a uniform length. The antibrachial membrane is less firmly bound down to the distal end of the forearm than is the case in the adult. The outlines of the legs are not sharply defined.

Measurements.

[U. S. N. M. 11320, Bayfield, Wis.]

	Millimeters.
Head and body (from crown of head to base of tail).....	1
Length of arm	1
Length of forearm	54
First digit:	
Length of first metacarpal bone.....	1
Length of phalanges.....	6
Second digit:	
Length of second metacarpal bone.....	27
Length of first phalanx.....	1½
Third digit:	
Length of third metacarpal bone.....	39
Length of first phalanx.....	11
Length of second phalanx.....	9
Fourth digit:	
Length of fourth metacarpal bone.....	39
Length of first phalanx.....	8
Length of second phalanx.....	7

Measurements—Continued.

	Milimeters.
Fifth digit:	
Length of fifth metacarpal bone.....	39
Length of first phalanx.....	8
Length of second phalanx.....	6
Length of head.....	16
Height of ear.....	13
Height of tragus.....	9
Length of thigh.....	12
Length of tibia.....	16
Length of foot.....	9
Length of tail.....	35

Measurements from first edition of Monograph.

Current number.	From tip of nose to tail.	Length of tail.	Length of forearm.	Length of tibia.	Length of longest finger.	Length of thumb.	Height of ear.	Height of tragus.	Expanse.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
5382	1.6	1.4	1.4	0.7 $\frac{1}{2}$	2.1	0.3	0.7	0.6	9.0
5384	1.6	1.4	1.4	0.7 $\frac{1}{2}$	2.3	0.3	0.7	0.3	9.0
5346	1.6	1.4	1.4	0.7 $\frac{1}{2}$	2.2	0.3	0.7	0.3	9.0
	1.8	1.4 $\frac{1}{2}$	1.4	0.7	2.3	0.3	0.6 $\frac{1}{2}$	0.3	9.0
5385	1.6	1.5	1.3	0.4 $\frac{1}{2}$	2.1	0.2 $\frac{1}{2}$	0.7	0.3	8.0
5370	1.6	1.4	1.2 $\frac{1}{2}$	0.4 $\frac{1}{2}$	2.2	0.3	0.7 $\frac{1}{2}$	0.3	9.0
5393	1.6	1.5	1.4 $\frac{1}{2}$	0.5	2.3	0.3	0.7	0.3	9.0
5352	1.10	1.8	1.6	0.5 $\frac{1}{2}$	2.4	0.3	0.7	0.4	9.2

List of specimens

Cat. No.	No of spec. mens.	Locality.	Presented by—	Nature of specimen.	Collection.
5384	1	Nova Scotia.....	Dr. Gilpin.....	Alcoholic.	U.S. Nat. Mus
5370	1	Brunswick, Me.....	A. S. Packard.....	do.....	Do.
5385	1	Elizabethtown, N. Y.....	S. F. Baird.....	do.....	Do.
5385	1	Phillipsburg, Pa.....	A. Brakeley.....	do.....	Do.
5382	1	Bradford, Pa.....	C. C. Martin.....	do.....	Do.
5381	1	Meadville, Pa.....	J. F. Thickstun.....	do.....	Do.
7196	1	Beaufort, S. C.....	Dr. Hayden.....	Dry.....	Do.
7197	1	do.....	do.....	do.....	Do.
3721	1	Michipico, Lake Superior...	C. A. Hubbard.....	do.....	Do.
5355	1	Portage, Lake Superior....	B. A. Hoopes.....	Alcoholic.	Do.
		Upper Mississippi River,			
5351	1	Illinois.....	R. Kennicott.....	do.....	Do.
5312	1	Racine, Wis.....	Dr. P. R. Hoy.....	do.....	Do.
5500	1	Gross Island, Michigan...	C. Fox.....	Dry.....	Do.
5318	1	do.....	do.....	Alcoholic.	Do.
5338	1	Detroit, Mich.....	Capt. Gunnison.....	do.....	Do.
5391	1	Brookville, Ind.....	Dr. R. Haymond.....	do.....	Do.
5348	1	Southern Illinois.....	R. Kennicott.....	do.....	Do.
5346	2	St. Louis, Mo.....	Dr. Engelmann.....	do.....	Do.
5362	1	Sonora, N. Mex.....	Arthur Schott.....	do.....	Do.
5435	1	do.....	J. H. Clark.....	Dry.....	Do.
5432	1	(?)	(?)	do.....	Do.
5503	1	(?)	(?)	do.....	Do.
5441	1	Sonora, N. Mex.....	J. H. Clark.....	do.....	Do.

2. *Vespertilio albescens* Geoff.

Vespertilio albescens Geoff., Annales du Mus., 1805, VIII, 204; Temminck, Monog. Mammifères, 1810, II, 244; Peters, MB. Akad. Berlin, 1866, 19; Dobson, Cat. Chirop. Brit. Mus., 1878, 326; Alston, Biol. Centrali-Amer., Mam., 1879-1882, 21.

Vespertilio brasiliensis Spix, Siniarum et Vespertilionum Brasiliensium species novæ, 1823, 63, tab. XXXVI, fig. 8.

Vespertilio leucogaster Wied., Beiträg. Naturgesch. Brasil., 1825, II, 271.

Vespertilio nubilus Wagner, Schreb. Säugeth., Suppl. 1844, I, 534.*

Diagnosis.—A white ring of fur across the space between the angles of the lower jaw conspicuous in alcoholic specimens. Auricle translucent, plicæ usually present, but do not extend to the outer margin; the dorsal aborescent lines infrequently present. The tip of the tragus is never acuminate; the convex basal half often ends abruptly and is followed by a narrower terminal portion; the basal notch is defined by the convex portion and the external basal lobe; the external basal lobe is not antiflexed. The face is scarcely swollen. The forearm measures from $31\frac{1}{2}$ mm to 46 mm long. The facial clump of glands is narrowed posteriorly; the supralabial groove does not extend to the mouth.

V. albescens, in its larger phase, closely resembles *V. gryphus*, from which it can be distinguished by the shape of the tragus and the shape of the clump of supralabial glands. When dwarfed, *V. albescens* closely resembles *V. nitidus*, from which it may be distinguished by the greater size of the thumb and foot. The membranes vary in color from bluish translucent black to dense opaque black. The anterior surface of the interfemoral membrane often whiter, that is to say, retains an appearance as though it were washed over with a milky fluid.

Vespertilio albescens, as seen by reference to the original description (see Appendix), was so named from the white color of the tips of the hair on the under surface of the body, a style of coloration in no wise peculiar. The general appearance of the pelage must have been somber, since the fur of the back is described as black, and that of the inferior parts obscure brown. As in the case with other original descriptions, it would be impossible, without examination of the type, to distinguish this bat from others in the fauna, and we are compelled to rely upon personal authority. Peters (M. B. Akad. Berlin, 1866, p. 19) rehabilitated *V. albescens*, but did not give a new diagnosis. He was content to point out the fact that *V. leucogaster*, Wied., and *V. nubilus*, Wagner, were the same as this species. Peters has been followed by Dobson, Alston, and J. A. Allen. The author last named extended its range from South America and Guatemala to Mexico.

Vespertilio brasiliensis, Spix, is described in terms similar to those of *V. albescens*, with the marked exception that the fur of the under surface of the body is black. But in a figure which accompanies the description, the color is of the same shade as is commonly seen in *V. albescens*. So far as the figure is concerned, no one would hesitate long in assign-

* The last two names are here included on the authority of Peters, who has examined the types.

ing Spix's form to the same species as Geoffroy's. I have examined specimens of *V. albescens* in the National Museum which have been received from the British Museum, and assumably are the same as those named by Dobson, that I am of the opinion that since in America no bat is known in which the fur of the under surface is black, that *V. brasiliensis* is the same as *V. albescens*.

It is important to ascertain the places of variation in this obscure species and a few notes on individuals are herewith appended. In No. 29840, Keeler County, Calif., collection of Agricultural Department, the foot presented the extreme measurement of 10^{mm} while the forearm was 35^{mm}, the length of the head and body 45^{mm}, and the tail 36^{mm}. Yet with these dimensions the thumb was 5^{mm} long only, and the postcalcaral lobe was absent. Of the phalanges of the manus those of the second row were scarcely shorter than those of the first, the greatest disproportion being noticed in the fifth digit when the lengths were as 8^{mm} to 5^{mm}. In No. 29855, Old Fort Tejon, Calif., *ibid.*, the individual was smaller. The forearm was 32^{mm} long, the foot 8½^{mm}. The head and body was 39^{mm} long, the tail 36^{mm}, the thumb remaining the same, viz, 5^{mm}. There was no postcalcaral lobe. The differences in the relative lengths of the digits were greater than in No. 29840, in the third digit being 10^{mm} to 8½^{mm}, in the fourth 8^{mm} to 6^{mm}, and in the fifth 8^{mm} to 4^{mm}. In No. 27974, ♂ Colorado River, Nevada, *ibid.*, the forearm was 31½^{mm} long, the foot 8^{mm}, the thumb 5^{mm}, the head and body 38^{mm}, the tail 29^{mm}; while the phalanges of the third and fourth were equal, in the fifth the proportions were as 6½^{mm} to 4½^{mm}.

If these proportions were constant, specific distinctions could easily be drawn. But unfortunately they are not so, and no two individuals will be found to conform to any diagnosis for specific characters which I have endeavored to frame. The auricle varied in detail on the outer border, especially as to the width of the first scallop and the tip. Peculiarities probably obtain according to altitude, character of food, degree of humidity in the atmosphere, etc. In No. 28972, Lone Pine, Calif., collection of Agricultural Department, the proportion of the tail to the body was as 32^{mm} to 39^{mm}, a great contrast to the foregoing phase. In No. 31569, San Emigdio, Calif., *ibid.*, the membranes and ears were black. The forearm was 36½^{mm}, being the greatest length of any individual examined in the United States (one specimen from Mexico measured 41^{mm}). The thumb was remarkably small, being 4½^{mm}, while the foot was 8½^{mm}. The length of the body was 49^{mm} and that of the tail 43^{mm}, thus being ample. The phalanges were subequal excepting those of the fifth digit, where the values were as 9^{mm} to 6^{mm}. This variety is too large for the type of *V. melanorhinus*. It is like *V. albescens* in having bluish translucent wings as in the diagnosis, but differing in the presence of large yet delicate frame and in greater deposition of pigment. Some of the black phases are noted as being found in growths of juniper. Is it possible that it is a mountain variety and that *V. erotis* is a phase

of the same? Alston (Biol. Centrali-Amer. Mam., p. 25) extends the range of *V. lucifugus* to Brazil and states that a specimen in the British Museum is so labeled. According to the views expressed concerning *V. lucifugus* under the head of *V. gryphus*, the lucifugan phase is a pedomorphic form. It is probable therefore that *V. albescens* has a pedomorphic form which can not be distinguished from the same form of the closely allied species *V. gryphus*. I have seen no such form, however, in collections made in the United States.

In the first edition of the Monograph, p. 56, I assign *V. lucifugus* a distribution as far south as the isthmus of Panama. I now believe that the Neotropical forms simulating *V. gryphus lucifugus* are examples of pedomorphism in *V. albescens*. C. H. Merriam identifies *V. lucifugus* (three specimens) in collections from Little Spring, at the north foot of San Francisco Mountain, Arizona.

Var (*a*).—*Vespertilio albescens evotis* (H. Allen).

Vespertilio evotis H. Allen, Monog. Bats N. A., 1861; Dobson, Cat. Chirop. Brit. Mus., 1878, 324; J. A. Allen. Bull. Am. Mus. Nat. Hist., 1893, v, 202; Merriam, Mammals of San Francisco Mt. Region, N. A. Fauna, No. 3, August, 1890, 46; Alston, Biol. Centrali-Amer., Mam., 1879-82, 1.

Description.—Head rather small; face pointed, moderately whiskered, snout produced; ears large, high, erect, oval, not turning outwardly, long, subacuminate, slightly diverging tragus; thumb slender; foot of moderate size; ample interfemoral membrane; last joint of tail exsert. The membranes are of a light brown color, tending in some to a darker hue. Hair long and soft, plumbeous at base behind, with light brown tips inclined to yellowish toward the head. The fur in front is dark maroon or black at base, with whitish tips. The basal third of the ear is covered with hair at base; at the base of the interfemoral membrane behind a tuft of hair is seen. In two specimens the fur had a darker tinge, the tips behind being dark olive-brown, the base being black. This variety has the largest ear of any of the American species of *Vespertilio*.

The above description is copied (with the substitution of the word "variety" for "species") from the first edition of the Monograph, page 48.

Herein is embraced a group of forms which find expression in the highlands of Montana, Washington, Colorado, and Arizona, though sparsely found in California.

The auricle is large, ordinarily coördinated with long, straight, slender tragus, though this is not constant; posterior border of the ear not emarginated; the membranes are almost always black; the foot is small; the tip of tail, as a rule, is moderately exsert; postcalcaral lobe often present; pigment in the second digital interspace is occasionally absent.

List of specimens examined.

Catalogue number.	Number of specimens.	Sex.	Locality.	Collection.
4960.....	1	.....	Fort Union, Dak.....	U. S. National Museum.
11192.....	1	.....	East of Colville, —.....	Do.
5391.....	1	.....	Arizona.....	Do.
8914.....	1	♂	Easton, Wash.....	Department Agriculture Deposit, U. S. National Museum.
31189.....	1	.....	.....	U. S. National Museum.
18683.....	1	♂	San Francisco Mountain, Arizona.....	Do.
28958.....	1	.....	Owens Lake, California.....	Do.
29090.....	1	.....	Inyo Mountains, California.....	Do.
30302.....	1	.....	San Joaquin River, California.....	Do.
29827.....	1	.....	Old Fort Tejon, Calif.....	Do.
28934.....	1	.....	Pahranagat Valley, Nevada.....	California Academy of Science.
329.....	1	.....	Belmont, Calif.....	Do.
327.....	1	.....	Lassen County, Calif.....	Do.
341.....	1	.....	Lake Tahoe, Nevada.....	Do.

All of the above exhibit the white transverse line between the angles of the jaw, which has been accepted as a character of *V. albescens*.

No. 29827 has a fringe of hair on the free border of the interfemoral membrane. Say describes his *V. subulatus* (see Appendix) as being similarly adorned. This is given by Dobson (*l. c.*) p. 323, as one of the characters of *V. levis* Is. Geoffrey (1824) from Uruguay. In 311890 ♂, from Easton, Wash., the forearm measured 33^{mm}, the thumb 5^{mm}, the foot 8^{mm}, tibia 17^{mm}, ear 16^{mm} in height, tragus 8½^{mm}, tail 40^{mm}. The phalanges of the third finger were equal, namely, 11^{mm}; those of the fourth subequal, namely, as 8^{mm} for first and 9^{mm} for second, and those of the fifth still further subequal, being 8^{mm} for the first and 6½^{mm} for the second. The post-calcaral and apici-calcaral lobes are absent and tip of tail not exsert. Ears and membranes intensely black. The shape of the ears (other than in length and color, and the general form of the interfemoral membrane) are quite as in *V. gryphus*. The coloration, especially of the front of the neck and the tragus are as in *V. albescens*. Is the variety modified by descent from the north and properly belongs to the eastern phase of *Vespertilio*, or has it come more directly from the south through *V. albescens*? I have accepted the latter hypothesis.

In four specimens of *Vespertilio* from San Francisco Mountain, Arizona, the United States Department of Agriculture, one No. 18693 ♂, adult, the forearm is 37^{mm}, ears 19^{mm} high, thumb 6^{mm}, tibia 17^{mm}, foot 8^{mm}, tail 33^{mm}, head and body 34^{mm}; two had no post-calcaral or apici-calcaral lobes, yet had exsert tail to the distance of 2^{mm}, and is named *V. albescens* *erotis*, while the other three, all adult females, were much alike in proportion of ears, thumb, feet, and forearm, and all were of the smaller ear form. One had post-calcaral lobes and scarcely any exserted tip to the tail; one, post-calcaral distinct lobes and distinctly exsert tip, while the third had no lobes, yet with distinct tip. Here *V. albescens erotis* is found in the same locality with the melanic form of *V. albescens*.

In No. 31189 ♂, Easton, Wash., the thumb is 6^{mm}, strongly hooked;

the forearm 33^{mm}, the tibia 17½^{mm}, the foot 7^{mm}, the head and body 41^{mm}, and the tail 39^{mm}. The central incisor strongly inclined inward, lateral giving the appearance of diverging incisors. Ears scarcely emarginate, external basal lobe higher than broad, membranes black, space beneath lower jaw not white. This is the typical *V. erotis* of the monograph. It would certainly be a distinct valid species if the southern forms did not show tendencies toward *V. albescens*.

Var. (b). *Vespertilio albescens melanorhinus* (Merriam).

Vespertilio melanorhinus Merriam, N. A. Fauna, No. 3, 1890, 46.

The following is an abridgment of the original description of *V. melanorhinus*:

Glandular prominence between eyes and nose inconspicuous; tail a little longer than head and body, the extreme tip projecting, ears shorter than head, shallow external emargination; tragus long and slender, directed forward and outward; convex at lower two-thirds, and then rapidly becomes narrower, and is sinuate and slightly concave on upper third. Thumb about half as long as the foot. Foot medium. Interfemoral membrane furred above to a little beyond the middle of tibia; postscapular lobe small but distinct; upper part uniform, dull golden brown, except the lips and face below and in joint of eyes, which parts are abruptly black; under part paler, palest posteriorly. Ears, face, and membranes black; underfur everywhere blackish, allied to *V. ciliolabrum*, from which it differs in having shorter ears and longer legs and tail, as well as in color.

No. 18684, ♂, San Francisco Mountain, Arizona, forearm, 31^{mm}; thumb, 4^{mm}; foot, 6^{mm}; head and body, 41^{mm}; tail, 41^{mm}; tip delicate, scarcely exsert.

The following embraces a study of the type of *V. melanorhinus*:

	Millimeters.
First phalanx, third digit	10½
Second phalanx, third digit	10½
First phalanx, fourth digit	8
Second phalanx, fourth digit	8
First phalanx, fifth digit	8
Second phalanx, fifth digit	6

Basal, half of auricle furred. Basal, three-fourths of fur above deep black; apical fourth, bright shiny golden brown. The interfemoral membrane thickly furred to knees and sparsely so almost to ankles. The proportions of basal black diminishes toward the rump, but the hair even on the interfemoral is obscurely bicolored. Basal, three-fourths below black; apical, fourth white with a slight mixture of a tawny shade. The interfemoral membrane clothed nearly to the knee with the same character of hair as on the neck, chest, and abdomen; but the basal proportion of black diminishes in proportion. Under surface of lower jaw not white. The prepuce blackish.

In specimen Nos. 29809 and 29810, Walker Pass, California, collection of Agricultural Department, the space under the lower jaw was black; the forearm measured 37^{mm}, the head and body, 45^{mm}; the tail, 44^{mm}; the thumb, 5^{mm}; the foot, 7^{mm}.

Millimeters.

First phalanx of the third digit	12
Second phalanx of the third digit	12
First phalanx of the fourth digit	9½
Second phalanx of the fourth digit	9½
First phalanx of the fifth digit	8½
Second phalanx of the fifth digit	6

V. albescens melanorhinus is essentially the same as the melanic form of *V. albescens*, excepting that the tips of the hair of the under surface of the body are whiter than is the rule with this species and the tragus is more than usually crenulated, and two of the situations are exceptionally deep near the basal part of the outer border. That the hair is disposed to be white on the under surface of the body is suggested by the names *albescens* and *leucogaster*. In a bat otherwise black, this contrast of color is striking.

Var. (c). *Vespertilio albescens velifer* (J. A. Allen).

Dr. J. A. Allen (Bull. Am. Mus. Nat. Hist., No. 1, p. 177, 18) has described a species of *Vespertilio* from Mexico, which he believes to unite the characters of *V. albescens* and *V. subulatus* (= *V. gryphus*). I have examined the skins upon which this diagnosis has been made and believe the form to be a variety of *V. albescens*. The following is the text of Dr. Allen's description:

Vespertilio velifer, sp. nov.

Size of *V. albescens*, with nearly the coloration of *V. nitidus* and the ears of *V. subulatus*.

Above basal two-thirds of the fur blackish, passing into dark broccoli brown at the surface; below much paler, the surface pale buffy gray. Pelage full and soft, extending on the membranes about as in *V. lucifugus*. Ears of medium size, similar in general form to those of *V. subulatus*, but rather narrower and more attenuate at the tip, the upper posterior third distinctly hollowed, the lower third abruptly much expanded; tragus long, rather narrow, fully or rather more than half the length of the ear, the front border nearly straight, the posterior border slightly rounded as far as a little beyond the middle, then sloping gradually to the rather narrow, but rounded tip, with a distinct notch opposite the anterior base.

Wings from the base of the toes; calcaneum strongly developed, feet large; thumb short, stout, with a rather thick claw; tip of last caudal vertebra free.

Length of head and body (measurements from dry skin), 44^{mm}; tail, 33^{mm}; ear, from base of inner margin, 14^{mm}; tragus, 9^{mm}; forearm, 42^{mm}; thumb, 8^{mm}; third finger (metacarpal, 38^{mm}; first phalanx, 13^{mm}; second phalanx, 12^{mm}; third phalanx, 10^{mm}), 73^{mm}; tibia, 17^{mm}; foot, 11^{mm}.

Skull broad, rather short; basilar length, 14^{mm}; total length, 16^{mm}; greatest width, 10.5^{mm}; lower jaw (front border to condyle), 13^{mm}. First upper premolar about twice the size of the second, both placed on the inner border of the tooth row.

Type, 2696, ad., Sta. Cruz del Valle, Guadalajara, Jalisco, September 7, 1889, Dr. A. C. Buller.

Three specimens, one male and two females, and six additional skulls, Sta. Cruz del Valle, Guadalajara, Jalisco, September 7 and 8, 1889.

These specimens agree very closely in size and coloration and in all other characters, and represent an apparently new species, quite different from any heretofore described. Its large size readily distinguishes it from any other known Mexican or North American species of the genus, except *V. albescens* Geoffroy, which it appears to equal in size, while differing from it almost as widely as possible in coloration, and also greatly in the size and form of the ear and in the very differently shaped tragus. Fortunately a Maximilian specimen of *V. leucogaster* Wied., a species currently synonymized with *V. albescens* (see Dobson, Cat. Chirop., pp. 326, 327), in the American Museum, enables me to make a direct comparison of *V. albescens* with the present species.

I have received a bat from Mr. G. S. Miller, jr., who obtained it from Dalyra, Cal., which answers so closely to *V. albescens relifer* (J. A. Allen) as to be at least a variety of this subspecies. The free margin of the interfemoral membrane from the calcars to the tip of the tail is conspicuously finbriated. The fur above is of a light tawny brown of the same shade as is met with in many Californian specimens of *Adelonycteris fuscus*. The under surface is tipped with white throughout, after a manner precisely the same as in *V. albescens*. The basal parts of the fur both above and below is intensely black.

Var. (*d*) *Vespertilio albescens affinis* (H. Allen).

Under the name of *Vespertilio affinis* in the Monograph of 1864 (p. 53) I describe an immature bat as follows:

V. affinis.—Head moderate, slightly depressed; face hairy; ears rather small, inner border convex, outer border concave. Tragus is subulate, about half as high as the ear, straight on internal side, diverging on the external. Lip whiskered. Body robust. Feet long and slender; a few curved hairs at the base of the nails; wing membrane, attached midway to base of toes. Interfemoral membrane rather small; a little lobe at the termination of the calcaneum; point of tail exerted. Thumb rather large. Wing membranes dark brown, but thin.

Fur thicker behind than before and extending a slight distance on the interfemoral membrane. Color lustrous light chestnut brown above; the same color of a lighter shade, inclining to yellowish below. The base of the fur above and below is of a delicate fawn brown.

The dentition is the same as in *V. erotis*, the incisors being the same length, the laterals bienspid.

V. affinis resembles *S. georgianus* (*Vesperugo*) in being about the same size and in the fur and membranes presenting the same general appearance. It differs from that species in having the ear more emarginated on the outer border; the tragus not blunt, nor so wide proportionately; the face more hairy and not so depressed; the reddish hue of the hair more decided; the fur thicker and less wavy. The dentition differs in there

being $\frac{6}{6}$ molars, instead of $\frac{5}{5}$. *V. affinis* has also a narrower interfemoral membrane and a marked calcareal lobe. On the dorsum the basal third of fur chestnut brown, apical half two-thirds lighter brown. The venter basal third deep brown (quite a different shade than that of the dorsum), while the tips are of a light gray, verging to white. The membranes from the tarsus. The coloration and the attachment of the wing membrane to the foot distinguish this variety. For the standard which existed for species at the time it was described, warranted its being placed under a separate heading from *V. subulatus*. It is immature,

This variation differs markedly in coloration from any bat of the genus in the fauna. This alone should retain the form. It holds relatively the same position as the preceding variation and *V. nitidus longicrus*.

3. *Vespertilio nitidus* H. Allen. The Californian Bat. (Plate XII).

Vespertilio nitidus H. Allen, Proc. Acad. Nat. Sci. Phila., 1862, 247; Monog. Bats N. A., 1864, 60; Dobson. Cat. Chirop. Brit. Mus., 1878, 318; Alston, Biol. Centrali-Amer. Mam., 1879-1882, 24.

Vespertilio agilis H. Allen, Proc. Acad. Nat. Sci. Phila., 1866, 279.

Vespertilio volans H. Allen, Proc. Acad. Nat. Sci. Phila., 1866, 279.

Vespertilio californicus (?), Bachman, Joarn. Acad. Nat. Sci., Phila., 1842, 280; Peale, U. S. Explor. Exped. (Mam.), 1858, 3.

Diagnosis.—Ears much as in *V. gryphus*; the first scallop equals in length the external border and tip; the external basal lobe tends to be higher than broad; the outer border of the tapering tragus convex at lower half disposed to be crenulated, the outer and inner border never forming the sides of an isosceles triangle. Tail ample, convex on lower margin. Tail subtriangular or obovate below the level of the ankles and the tip exsert only in the pedomorphic forms. The first metacarpal bone parallel to the second.*

It is a question whether *V. californicus* Bachman (*vide* Appendix) should be accepted as a name for this species. I have concluded that the description does not sufficiently identify it. It is simply known to have been a western bat (for the word *californicus* need not necessarily have meant in 1842 the State of California as now restricted) having vespertilionine features as shown in the "sharp nose" and "linear attenuated tragus." The "light yellowish-brown" fur suggests that it may be the same as *V. nitidus macropus*. Since the type specimen is lost I have thought best not to attempt to rehabilitate this species.

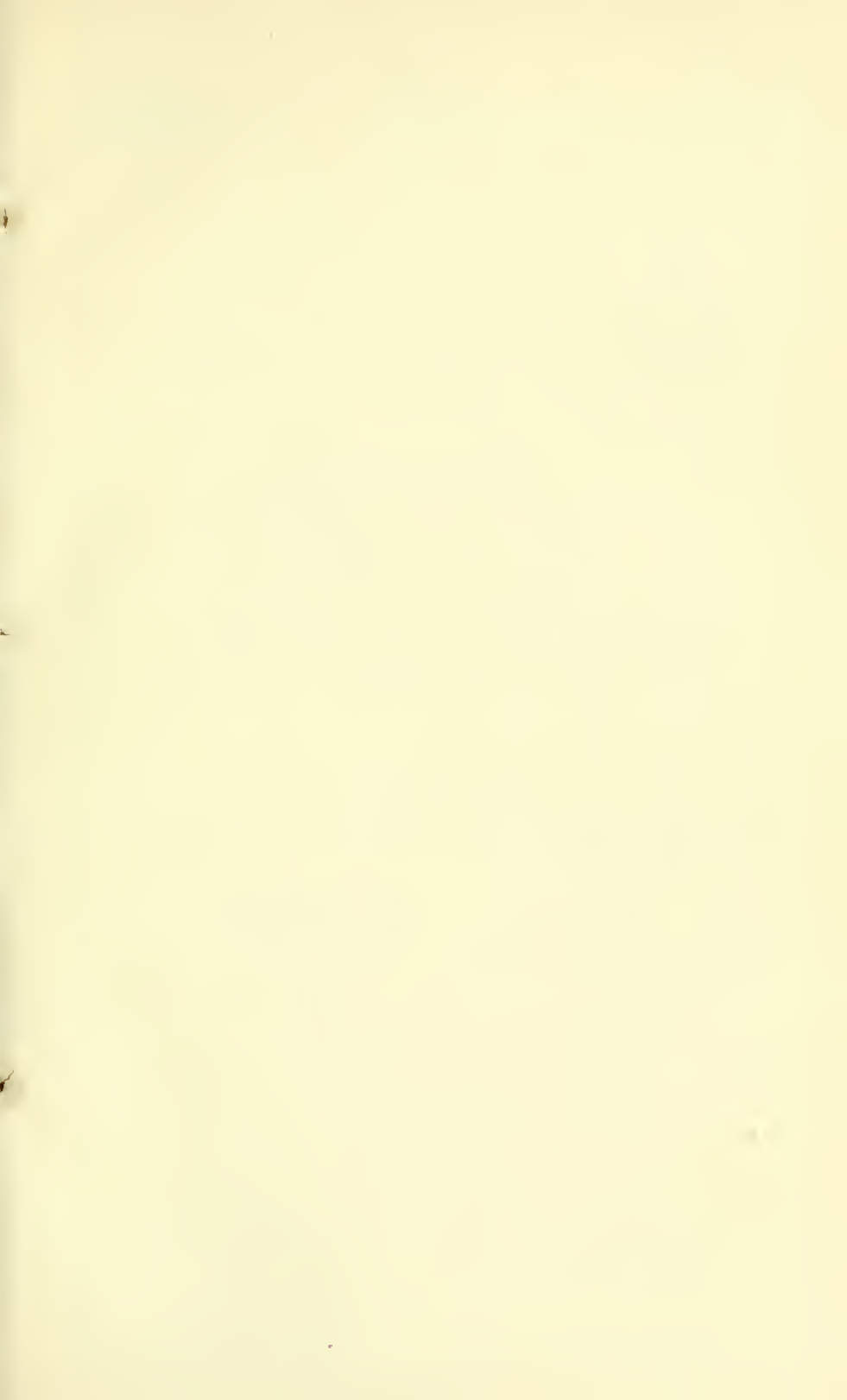
Description.—Dorsum light or dark chestnut brown with individual variations of olive brown, tawny, or gray colors. The base of the hair is of a deep black except at the rump where it is unicolored. The sparse hair on the back of the interfemoral membrane usually extends as far as the level of the feet; it is occasionally confined to the region of the basal third of the tail. The under surface of the body is of a lighter shade of brown than the dorsum. The gray tints gradually increase from above downward and are conspicuously developed at the pubis in some specimens. In the most marked examples of this tendency it

*Alston (Biol. Centrali-Amer., 1879-1882, 24) gives the following differential diagnosis between *V. nitidus*, *V. nigricans*, and *V. lucifugus*.

V. nitidus.—Ears as long as head; muzzle slender, pointed; thumb shorter than foot, which is small; tail wholly included in membrane. Forearm 1". 20". Fur reddish brown above; reddish gray beneath.

V. nigricans.—Ears shorter than head; muzzle obtuse; thumb as long as foot. Forearm 1". 30". Fur sooty rust-color.

V. lucifugus.—Ears as long as head. Forearm 1". 40". Fur olive-brown, grayish below,



EXPLANATION OF PLATE XII.

- FIG. 1. Front view of head of *Vespertilio nitidus*.
FIG. 2. Side view of same.
FIG. 3. View of tragus and inner side of auricle.
FIG. 4. Front view of head of *Vespertilio nitidus erotis*.
FIG. 5. Side view of same.
FIG. 6. Wing membrane of *Vespertilio nitidus*.
FIG. 7. Tail and interfemoral membrane.
FIG. 8. The skull seen from above of same. x 2.
FIG. 9. The skull and lower jaw seen from the side of same. x 2.
FIG. 10. A variant form of skull of same. x 2.
FIG. 11. The skull of *Vespertilio nitidus ciliolabrum*. x 2.



1



2



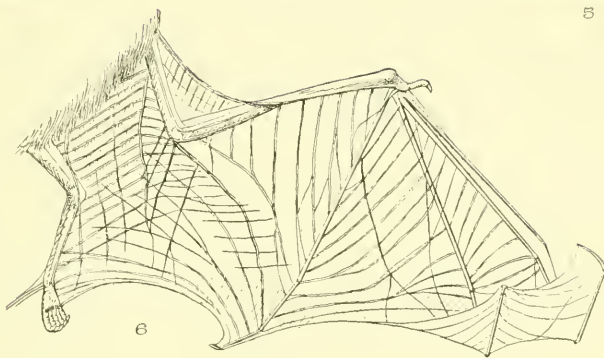
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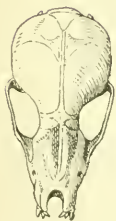
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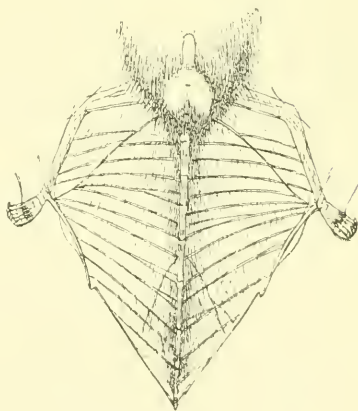
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11

1, 2, 3, 6, 7, 8, 9. *VESPERTILIO NITIDUS*.
10. *VESPERTILIO NITIDUS*, VARIETY.

4, 5. *VESPERTILIO NITIDUS EVOTIS*.
11. *VESPERTILIO NITIDUS CILIOLABRUM*.

is less decided than in *V. albescens*. The gray color is also quite commonly seen at the space beneath the lower jaw as far back as the oral angles.

A scattered growth of gray hair occupies the ventral aspect of the wing membrane at its upper half from the body to near the elbow. The membranes are ample. The caudal series of vertebrae from the rump to the ankle one-third the distance from the ankle to the non-exsert tip. Postcalcaral lobe as a rule well developed and supported by a rod derived from the calcar. The length of the forearm ranges from 29^{mm} to 33^{mm}.

Variations—The variations of *V. nitidus* are numerous. They embrace changes in color of the fur, ear, membranes, and the proportions of the thumb, feet, legs, and forearm. Pedomorphic variation is extremely common. Before definite conclusions can be reached as to the limitations of the group elaborate study of more extensive material will be necessary.

The species of such distinguished writers as Dr. C. Hart Merriam and Mr. F. W. True can not be lightly put aside, and I am far from believing that the form *V. ciliolabrum* and *V. longicrus* are not additions to our knowledge. I place their descriptions, therefore, not in the Appendix, but in the text under *V. nitidus* where they find their proper place as subspecies or as members of groups otherwise aberrant, but not well known.

The specimens of *V. nitidus* from Mexico are of a reddish color on the dorsum. The foot, thumb, and tail as in California specimens. The length of the forearm is 28^{mm} to 29^{mm}; the head is two and one-half to three times as long as the foot; the tip of the tail is, as a rule, not exert, the interfemoral membrane is ample. In a specimen from Jalisco, Mexico (American Museum of Natural History), the colors are everywhere darker; so dark, indeed, that at first sight it might be taken for a distinct form. Specimens from California are of four varieties of coloration on the dorsum, the chestnut, the olive, the tawny, and the gray; and are thus arranged in the order of the frequency of the several kinds. The tawny and gray are infrequently seen. Darker shades are apt to prevail toward the northern range of the Pacific slope.

Oregon and British Columbia have a nitidian bat not found elsewhere, viz, one in which the basal black of the hair is of a brown shade instead of black, and is thus not in so great contrast with the color of the tip as is the case with the southern specimens. The forearm is 31^{mm} to 36^{mm} long; the head one and one-half times to twice as long as the foot; the tip of the tail is exert, the thumb measuring from 4^{mm} to 5^{mm}.

In a series of four skins collected by Mr. C. P. Streater (Am. Mus.) the dorsum was without the deep basal black, and in its stead an obscure shade of deep fawn which passed gradually to the ash or sooty tip. The venter was much more gray than in the southern examples.

The foot was large, equally one-half the length of the head; the post-calcaral lobe was absent. The caudal series from rump to ankle a little less than one-half the distance from the ankle to the tip. The length of the forearm ranged from 30^{mm} to 33^{mm}. This variety, therefore, may be accepted as pedomorphic. Immature specimens from Alaska appear to be of this variety. The color of a specimen from Beaverton, Oregon, is dark olive-brown, quite as in *Adelonycteris fuscus* with lighter shades anteriorly. Those from British Columbia are much darker, verging from dark gray to brown-gray.

Two specimens of *V. nigricans*, Nos. 3213 Panama and 4522 n. l. (Mus. Comp. Zool.), agree with the specimen from the American Museum of Natural History in having the foot 7^{mm} long. These do not materially differ from two specimens collected by Dr. Benjamin Sharp at Tobago, West Indies, in which the external basal lobe was broader than high, the fur black. I regret that the material at my disposal is not of a character which enables me to determine the precise relations obtaining between *V. nigricans* and *V. nitidus*. The vespertilionine bats of the west coast of the United States closely resemble *V. nigricans*. I am not sure but that *V. nitidus* must be accepted as a geographical variety of this South American form; practically there is no difference between the two varieties excepting the shape of the external basal lobe of the ear and the color of the hair of the dorsum, which is darkish gray to black in *V. nigricans* and reddish-brown in *V. nitidus*.

In a melanic specimen 28950, collected by C. H. Merriam, at Panaca, Nevada, (Collection of Agricultural Department), the leg measured 12^m, the forearm 37^m, the auricle 12^m, the foot 7^m, and the tragus 5^m, while the post-calcaral lobe was large, and the tail exsert. These proportions are quite different from those of the average *V. nitidus*.

In the dark sienna (almost black) brown of the back and the scarcely lighter shade of the same color of the chest and abdomen, a specimen collected at Queen Charlotte Island, by Mr. J. H. Keen, and kindly sent me by Dr. C. H. Merriam, no trace of white color marked the space between the lower jaw.

In No. 24223 ♂, Rosebury, Oregon (Collection of Agricultural Department), the same deep brown to black colors obtain. The tragus is semipyriform and of the height of the first scallop, which is conspicuously convex. The interfemoral membrane below the level of the ankles is triangular, with the tip of tail boldly exsert. The forearm is 32^m, the thumb 5^m, the tibia 15^m, the foot 8^m, head and trunk 39^m, and the tail 32^m. The upperlateral incisor is not parallel to the central. The external basal lobe tends to be broader than high and the space beneath the lower jaw, while less white than in the more southern examples, was not of the same color as the rest of the fur on the under surface of the body.

No. 24011 Blue Creek, Washington (Collection of Agricultural Department), closely resembles *V. nitidus*, but is of a uniform black color. The feet and interfemoral membrane are precisely as in the species

named, but the thumb is larger and the external basal lobe a mere nodule.

V. agilis and *V. volans* which appear to be sufficiently distinct to warrant placing them in varieties of *V. nigricans*.^{*} *V. yumanensis* of the Monograph of 1864 is undoubtedly an immature specimen of the same species. All the varieties of *V. nigricans* exhibit a disposition for the upper portion of the tragus to be crenulated; this is marked in *V. yumanensis*. In typical expressions *V. nigricans* from Brazil as well as the varieties from Peru (also described in the doubtful *V. oxyotus*, Peters) exhibit crenulations; the character, however, can not be relied upon as distinctive, since individuals of *V. gryphus* from eastern localities of the United States occasionally exhibit it.

Skull and teeth as in *V. gryphus*, excepting that the crenulated cingulum of the maxillary lateral incisor is less well developed.

Characters of immature specimens.—The colors of immature specimens, excepting the aberrant *V. yumanensis*, are more black on the dorsum than in the adult. The tips are obscurely and irregularly tipped with brown on the dorsum about in the same manner as the tips are silvery in *L. noctivagus*. On the venter the distribution of the gray tips is more uniform. The white color of the under parts of the jaw (seen also in *V. albescens*) is absent in the immature. In an individual 28^m long no fur was seen on the upper parts of the head and trunk except over the neck where a patch of olive brown hair was seen. The sides of the neck were also sparsely covered with hair of the same color. The under parts were thinly covered with very short whitish hair. The upper third of the interfemoral membrane and all the thighs were rather thickly covered with coarse olive-brown hair. The tips of the fourth and fifth fingers were marked by a few minute

^{*} The varieties of *V. nigricans* embrace all forms which I described in the proceedings of the Academy of Natural Science, of Philadelphia, in 1886 (Notes on the Vespertilionidae of Tropical America), containing the names of *V. mundus*, *V. cinnunus*, *V. exiguus*, *V. obscurus*, *V. exilis* and *V. tenuidorsalis*. I now look upon these provisionally described forms either as geographical or pedomorphic. The first four mentioned, namely, *V. mundus*, *V. exiguus* and *V. obscurus* belong to the dark variety, while *V. cinnunus* resembles *V. nigricans* from the chestnut-red tints on the dorsal fur. *V. exilis* and *V. tenuidorsalis* again are of the *V. nitidus* type in the color of the dorsal fur. A due consideration of my statements in this paper would have clearly shown that these forms were never distinctly offered as species, but that they were submitted provisionally only under their separate names. It was hoped that the descriptions might be appended without confusion to the available meager diagnoses of the South American species. My position in this matter has been misunderstood. If I had denoted these varieties by number, or any other arbitrary means, it would have been to my mind as significant as naming them. According to the method of the Nuttall Ornithological Club of naming geographical subspecies by trinomials some of these names may get be available in studies of *V. nigricans* and *V. nitidus*.

The likelihood that tropical species of *Vespertilio* extend their range along the entire western coast makes it desirable to have exact knowledge of the South American forms. With the exception of *V. albescens* (which is undoubtedly distinct from *V. nigricans*) I have no acquaintance with these species. *V. polythrix* and *V. oxyotus* are probably synonyms of *V. nigricans*.

hairs. In an example measuring 32^{mm} the parts were marked as above but in addition the entire dorsum was uniformly covered with short olive-brown hair.

Habits.—Our knowledge of the habits of *V. nitidus* and its varieties is very scanty. As above stated I think it likely that when all the facts concerning this species and its associates are collected that it will be found that it is very close to, if not identical with the forms now known as *V. nigricans*, *V. chiloensis*, etc. It is warrantable, therefore, under such an assumption to include all notes of the habits of these and of specific descriptions of individuals which may be shown to be synonymous herewith.

V. chiloensis in an islandic variety. Bats can readily take flight from the mainland to an island of greater distance than Chiloe (vide *L. noctivigans* and *Atalapha cinerea*). In commenting on the habits of *V. chiloensis* Darwin says: "It is not, I believe, common, nor do the humid and impervious forests of that island (Chiloe) appear a congenial habitation for members of the family. It must, however, be observed that even in Tierra del Fuego, where the climate is still less hospitable, and where the number of insects is surprisingly small, I saw one of these animals on the wing." The description and figure of *V. chiloensis* Waterhouse (Zööl. Voy. Beagle, Mammalia, 1838, 5) answers very well (except that it is without gray color of fur on the inferior surface of the body) to *V. nigricans*. Many specimens, which I have examined from California and Oregon, could not be, in the main, better described and delineated.

The dark hues of *V. chiloensis* recall those of examples of *V. nitidus* which have been collected in Oregon. Is the humid character of this portion of the coast-wise range sufficient to account for the difference in coloration from the Californian varieties? It would appear to be true that the lighter shades of brown and gray are associated with dry, hot plains and the darker hues with forests, especially when these cover high hills or humid mountains. Unfortunately nothing is said upon this subject by collectors. The nature of the food, so important a factor in preserving coloration in mammals and birds, is also never vouchsafed. While we know in a general way that the species with its congeners are insectivorous, the kinds of insects selected is unknown. From the large numbers of immature forms (as compared with the adult) in the Merriam collection I assume that many were obtained either from caves or hollow trees.

Melanic and pedomorphic forms of *V. nitidus*, as already remarked, are common. A careful examination of the material recently collected by W. S. Bryant in Lower California, for the California Academy of Science, and by C. Hart Merriam, for the Agricultural Department, has not resulted in bringing the confusion which exists in my mind respecting *V. nitidus* into order. In specimens collected from the State of Washington to the lower part of Lower California, the same disposition prevails, namely, to have a bat with a forearm ranging in length from 30^m to 35^m in length; a small, delicate thumb not exceeding 3^m to 3½^m in

length, and a long, delicate tail and nonexsert tip parts, which conform to *V. nitidus* (nob.), intermingling with other phases in which the thumb is much larger viz, 4^m to 5^m, the tail small and more exsert, while the general size of the individual is much the same, that is to say, not indicative of any distinctive peculiarities in size.

Measurements.

Millimeters.

Head and body from crown of head to base of tail	
Length of arm	6
Length of forearm	28
First digit:	
Length of first metacarpal bone	21
Length of first phalanx	1½
Second digit:	
Length of second metacarpal bone	25
Length of first phalanx	1½
Third digit:	
Length of third metacarpal bone	25
Length of first phalanx	9
Length of second phalanx	10
Fourth digit:	
Length of fourth metacarpal bone	25
Length of first phalanx	7
Length of second phalanx	6
Fifth digit:	
Length of fifth metacarpal bone	25
Length of first phalanx	6
Length of second phalanx	5
Length of head	14
Height of ear	10
Height of tragus	7
Length of thigh	12
Length of tibia	13
Length of foot	5
Length of tail	36

Measurements from first edition of monograph.

Current number.	From tip of nose to tail.	Length of tail.	Length of forearm.	Length of tibia.	Length of longest finger.	Length of thumb.	Height of ear.	Height of tragus.	Expanse.	Nature of specimen.
	In.	In.	In.	In.	In.	In.	In.	In.	In.	
5433.....	1.8	1.3	1.3	0.6	2.3	0.3	0.5	0.2½	8.0	Dry.
5432.....	1.8	1.0	1.3	0.6	2.0	0.3	0.6	0.3	8.0	Do.
5446.....	1.6	1.0	1.2	0.6	1.9	0.2	0.4	0.2	7.0	Do.
523.....	1.7	1.0	1.3	0.6	2.0	0.3	0.5	0.2½	7.9	Do.
5444.....	1.3	1.1	1.2	0.5	1.9	0.2½	0.4½	0.2½	7.0	Do.
525.....	1.7	1.2	1.3	0.6	2.0	0.3	0.4½	0.2½	7.7	Do.
1207.....	1.7	1.2	1.3	0.6	2.9	0.3	0.4½	0.3	(?)	Alcoholic.
5498.....	1.6	1.5	1.2	0.6	2.0	0.3	0.6	0.3	7.9	Do.
5500.....	1.7	1.4	1.2	0.7	2.3	0.3	0.5	0.3	8.5	Do.
5499.....	1.6	1.2	1.2	0.6	2.1	0.3	0.5	0.3	7.9	
5368.....	1.6	1.3	1.2	0.6	2.1	0.1½	0.6	3.0	8.0	Do.
	1.5	1.4	1.1½	0.6	2.1	0.2	0.6	3.0	8.6	Do.
5535.....	1.6	1.1	1.2½	0.6	2.0	0.2	0.6	3.0	7.6	Do.
5536.....	1.5	1.6	1.2	0.6½	2.1	0.2½	0.6	3.0	8.0	Do.
5565.....	1.6	1.3	1.3	0.6	2.6	0.2	0.6	3.0	8.0	Do.
5534.....	1.4	1.2	1.1½	0.5½	2.0	0.1½	0.6	3.0	7.0	Do.
5537.....	1.5	1.3	1.2	0.6	2.3	0.2	0.6	3.0	8.0	Do.
5405.....	1.6	1.2	1.2	0.6½	2.1	0.2	0.6	3.0	8.0	Do.

List of specimens.

Cat. No.	No. of specimens.	Locality.	Presented by.	Nature of specimen.	Collection.
5432	1	Guadalupe Cañon, N. Mex.	Capt. J. Pope	Dry	U. S. Nat. Museum.
5436	1	Pecos River, Tex.	do.	do	
5394	1	Santa Fe, N. Mex.	W. J. Howard	Alcoholic	
5536	1	East of Fort Colville.	A. Campbell	do	
5583	6	Puget Sound.	do.	do	
7004	1	do.	do.	do	
5568	1	Fort Steilacoom, Wash.	Dr. Geo. Suckley	do	
5535	1	do.	do.	do	
5444	1	do.	do.	Dry	
5446	1	do.	do.	do	
5434	6	do.	do.	Alcoholic	
7005	1	San Francisco, Cal.	R. D. Cutts	do	
5437	1	Monterey, Cal.	W. Hutton	do	
1207	1	do.	A. S. Taylor	do	
5368	17	Fort Tejon, Cal.	John Xantus	do	
5405	1	Fort Yuma, Ariz.	Maj. Geo. H. Thomas, U. S. A.	do	
5537	2	do.	do.	do	
5533	1	Cape St. Lucas	John Xantus	do	
5402	1	do.	do.	do	
5398	1	do.	do.	do	

Var. (a). *Vespertilio nitidus macropus* (H. Allen).

Vespertilio macropus H. Allen, Proc. Acad. Nat. Sci. Phila., 1866, 288.

The following is the description of this variety, provisionally described as *V. macropus*. Above, fur long, silky, three-fourths black, apical fourth uniform, light russet brown, a small clump at the base of interfemoral membrane. Beneath, same proportion as above, being at base black, at tip grayish-white, pure white at pubis; fur extends laterally on membrane midway to elbow. Wing membrane attached midway between base of outer toe and ankle joint. In other respects it closely resembles *V. subulatus*.

Measurements.*

Height of ear	6'''
Height of tragus	3½'''
Length of humerus	1'' 4'''
Length of thumb	3'''
Length of foot	4½'''
Length second joint index finger	1'''
Expanse	8'' 3'''

This form has the light reddish brown color to the fur on the dorsal surface of the body as in the Sonoran varieties of *V. nitidus*. The foot is very large and the interfemoral membrane triangular below the level of the ankles and the tip of the tail is exsert. As above stated the resemblance to *V. subulatus* (*V. gryphus*) in this regard is close. *V. nitidus macropus* I believe to be a pedomorphic form of *V. nitidus*, but owing to peculiarities of environment retains the light yellow brown hues so common in desert living individuals.

Two other specimens were included in the collection sent me by Dr. Cones at the same time with the foregoing. I named these forms *V.*

* Mature. Dr. Cones' private collection, near Fort Major, Colorado River, New Mexico. Dr. E. Cones, U. S. Army.

subulatus. I now believe them to be members of the same group with the next variety (q. v.) of *V. nitidus*.

Var. (b). *Vespertilio nitidus ciliolabrum* (Merriam). (Plate XII.)

Vespertilio ciliolabrum Merriam, Proc. Biol. Soc. Washington, IV., 1886-'88, 1.

The following is an abridgment of the original description of *V. ciliolabrum*:

Ear as long as the head; calcar occupies one-half the free margin of the interfemoral membrane; post calcar lobe large; apici-calcaral lobe developed; internal basal lobe slightly rounded; outer margin auricle sharply emarginated (concave) for about one-third of its entire length; first scallop at first abruptly convex, then straight; external basal lobe (reflexed lobe) distinct. Tragus as in all western forms. Thumb very small, considerably shorter than foot. Foot small. Half of last vertebræ free.

Fur long and soft; basal portion dusky, apical portion varying from whitish or yellowish white to isabella-brown (tawny-isabella in the New Mexico specimens), which in some individuals is nearly as dark as in *V. subulatus*; the colored apical portion varies in extent from less than one-third to more than one-half the length of the hairs.

Dr. Merriam believes *V. ciliolabrum* to be allied to *V. nitidus*. The ear is larger and in other proportions, and in color it is distinct.

Habitat.—Trego County, Kans., and subsequently collected in Grant County, southwest corner of New Mexico. Mr. A. B. Baker the discoverer states that it was found in bluffs or canyons near the town of Banner and well hidden away in clefts in the chalk rocks. Others occupied abandoned swallows' nests which were inaccessible; but they were easily dislodged by means of stones. Mr. Baker has informed me that the locality for this subspecies no longer exists.

Measurements.

	2794 ♂ ad. Merriam coll.	2797* ♀ ad. Merriam coll.	27055 Pahrump Valley, Neb.
	mm.	mm.	mm.
Head and body.....	42.	43.	39.
Head.....	16.25	16.25	.....
Tail.....	37.	40.	39.
Ear from inner basal angle.....	15.	15.	.....
Tragus.....	6.75	6.75	.....
Humerus.....	22.	22.	.....
Forearm.....	32.50	33.	31.
Thumb.....	3.75	3.50	4.
Third finger.....	56.	56	.....
Fifth finger.....	44.	45.50	.....
Tibia.....	11.25	11.50	13.
Hind foot.....	7.	7.50	5.
Width of second interspace.....	.....	.....	2.50
Width of third interspace.....	.....	.....	10.
Width of fourth interspace.....	.....	.....	27.

* Type.

In specimen No. 27061, Death Valley, California, the thumb is 3mm; post-calcaral well developed, no apici-calcaral lobe; the tail is as long

as head and body, ample, convex on sides; interfemoral membrane is sparsely haired to ankles above.

The upper first and second upper premolars are invisible from without; ears furred at basal one-half; tragus with distinct spine at upper border of the basal notch, and crenulated near tip. In all the forms the hair on the interfemoral membrane almost to the ankle; forearm, 30^m; hair deep black at base; light golden yellow to light brown above; white beneath.

The following list includes the specimens of this subspecies in the collection of the Agricultural Department:

- 27054 ♀ Vegas Valley, Nevada.
- 27055 ♀ Pahump Valley, Nevada.
- 27056 ♂ Colorado River, Lincoln County, Nev.
- 27059 ♂ Death Valley, California.
- 27060 ♂ Death Valley, California.
- 27058 ♂ Death Valley, California.
- 27061 ♂ Death Valley, California.
- 27051 ♂ Amargosa River, California.
- 30731 ♀ East Fork Keweenaw River, California; dark chestnut brown above, light buff beneath.
- 30730 ♀ *Ibid.*

In specimen No. 2786 ♀ and No. 2787 ♂ collected by E. Cones at Fort Whipple in 1862, the outer margin of the ear scarcely concave, first scallop not sharply defined above; external basal lobe thick, rigid, sharply incurved. All parts of body and of membranes delicate, facial proportions slender, nose pointed. Interfemoral membrane above sparsely haired almost to ankle; post calcareal well developed; apici calcareal long, projecting. Tail 19^m to ankle; 17^m from ankle to tip; tip not exsert. Tail in 2786 straight to within three segments of end, then it is abruptly flexed. In 2787 it is curved throughout as in *Vespertilio* generally, and the apici-calcareal not projecting; post calcareals absent.

Here, in two examples, the contrast as to the lobes about the calcar and the shape of the tail is marked. The degree of hairiness on the upper surface of the interfemoral membrane is the same in the two sexes. I can not distinguish this form by any valid character from a group of specimens (five in all, 18776 to 18780, all females) in the collection of the Agricultural Department, from Oracle, near Tucson, Ariz.; one of these, No. 18778, is taken as a basis for the following notes:

Basal lobe not thickened at free border, scarcely incurved; the post calcareal lobe a mere hem; the membranes are not black; the glands on the side of the face swollen, ovate mouth cleft, not reaching the posterior canthus; the thumb 4^m long; the foot 5^m long; the head and trunk 38^m; the tail 35^m long, longer than body; forearm 30^m.

These examples are nearly identical with skins of E. Cones from Fort Whipple. Very light chestnut brown above, white beneath the jaw; tragus semipyriform; lateral incisor small and parallel to central interfemoral membrane, milky in front. This group of individuals exhibit characters combining those of *V. albescens* and *V. nitidus*. A

lighter shade to the fur and a slightly smaller thumb would readily carry them over to *V. nitidus ciliolabrum*.

Two examples (No. 12450, U. S. N. M., both gravid females) collected by Mr. H. W. Henshaw, near Wingate, N. Mex., in 1872, presented such marked color phases as to suggest that if these prove to be constant in individuals collected from this portion of the country that a separate geographical subspecies of *V. nitidus* be based upon them and the somewhat similarly colored specimens from the Death Valley region. The fur is long, silky, nearly white above in one specimen, and brilliant light aureous in the second. Both specimens are quite white beneath. Interfemoral membrane hairy above nearly to ankle, the back of thigh and leg being covered. The general proportions are quite as in the type of *V. nitidus*. If subsequent observation confirms such subspecific determination, the name *V. nitidus Henshawii* may be given it. Mr. Henshaw was the first collector who brought this phase of vesperilionine life to the attention of naturalists.

Var. (c). *Vespertilio nitidus longicrus* (True).

Vespertilio longicrus F. W. True, Proc. U. S. Nat. Mus., 1887, 6.

The following is the original text of the description:

Glandular prominences of the sides of the face well developed, as in *V. lucifugus*, making the muzzle appear blunt. Ears shorter than the head; laid forward they do not reach the nostrils by a millimeter; inner margin evenly convex from lobe to tip; upper third of outer margin scarcely concave, lower two-thirds rather strongly convex. Length of the tragus slightly more than one-half the height of the ear; inner margin concave, outer margin convex, crenulate; tip rounded off.

Wings from the base of the toes; foot less than one-half the length of the head. Tail long. Interfemoral membrane deep antero-posteriorly; the hinder margin straight in the posterior half. Calcaneum ending in a small rounded lobe in the middle of the hinder margin of the interfemoral membrane; the margin between this lobe and the foot very convex. Only the cartilaginous extremity of the tail free. Tibia very long, exceeding the head by nearly one-fourth.

The fur of the body extends on the interfemoral membrane along the tail as far as a line joining the centers of the tibiae. The fur above uniform amber colored, or slightly lighter at the extremities; beneath, amber in the basal three-fourths, dull Naples yellow in the apical fourth. Membranes dull brown.

Skull with the face very short and the brain-case greatly elevated. Teeth as in *V. lucifugus*, except that the first upper premolar is not crowded behind the canine.

On account of the length of the tibia I have thought it appropriate to name the species *Vespertilio longicrus*.

It is evident that it is closely allied to *V. lucifugus*, but it is readily distinguishable from that species by its shorter and broader ears, longer tibiae, smaller feet, and duller color.

Measurements of Vespertilio longicrus, 15623, Puget Sound.

	Millimeters.
Length of head and body.....	47.5
Length of head	16.0
Height of ear	12.5
Length of tragus.....	6.5
Length of forearm	39.0
Length of thumb	6.0
Length of tibia	20.0
Length of foot.....	7.5
Length of tail	45.0

In this species of Mr. True, the short ear, with its sharply concave outer margin, the short noncrenulate tragus, the dark color of fur on the under surface of the body, the long tibia, with triangular shape to the intermoral membrane below the line of the ankles, separate this form from other bats which have been collected in the region of the northwest. If other examples sustain the peculiarities, *V. longicrus* is undoubtedly a distinct species. It is likely, however, to prove to be a variant of the eastern forms modified by migration to the north and west. In the event of this proving to be the case, it becomes a subspecies of *V. gryphus*. *V. longicrus*, while a member of the humid coast line of the west coast of North America, is unlike other individuals which have been collected from the same region. The peculiar excavation of the outer border of the auricle and the length of the tibia have not been repeated in other specimens.

Note on Vespertilio subulatus, Say.*—Attempts to rehabilitate *V. subulatus*, so as to admit it in the group of western forms, has proved to be as difficult as is the case for all the North American bats where the types are unknown. This is especially true of species described in the first half of the present century. To make the admission valid it is necessary that Say's description should answer to the descriptions of *V. albesceus*, *V. nitidus*; or one of the subspecies of these forms. The reader must judge for himself with what degree of justice any of the names of the herewith defined forms, either reestablished by acquaintance with types or secured by detailed description at the hands of accomplished zoölogists, should be put aside in order to restore a form which has been imperfectly described (see p. 187) from a single immature specimen.

Genus **LASIONYCTERIS** Peters.

Lasionycteris Peters, MB. Akad. Berlin, 1865, 618.

Vesperides Coles and Yarrow, Wheeler's Exped., Zool., 1875.

Diagnosis.—Ears with whitish internal basal lobe; outer border and outer basal parts with membranous flange. Tragus of peculiar shape, short, blunt, with straight inner and convex outer border. Face hairy. Wings to base of toes; no calcaral lobe or tip; tip of tail exerted. Foot and thumb of one length and a little less than one-fifth as long as the forearm. Hair dark, plumbeous or blackish, with tips conspicuously dashed with gray or white. Dorsal four-fifths of interfemoral membrane with numbers of minute warts arranged transversely and furnished with a sparse growth of hair. The first phalanx in the third, fourth, and fifth fingers longer than the second.

Dental formula—molars $\frac{3}{3}$, premolars $\frac{2}{3}$, canines $\frac{1}{1}$, incisors $\frac{2}{3}$ $\times$ = 36 teeth.

The manual formula is as follows:

	Millimeters.
First interspace.....	1
Second interspace.....	4
Third interspace.....	25
Forearm.....	37-38

* For literature of *V. subulatus*, see p. 76.

Previous to the date of the Monograph of 1864, this genus had been embraced in *Vespertilio*. In considering it a species of *Scotophilus* I made an error. The difference in the number of the molars, the two genera, should have influenced me in not including the form in any of the genera known at that time. "The trifling difference in the number of the teeth does not afford a sufficient reason for considering them (the North American Vespertilionine species) as different" (Leconte). I was influenced by this opinion in not separating *Lasionycteris* from its congeners. While Maj. Leconte, a leading authority in his day, was so doubtful upon the subject of the value of the variations in the dental formula he placed great importance on the minute changes in form of the outer ear.

1. *Lasionycteris noctivagans* (Leconte). The Silvery Bat. (Plates XIII, XIV.)

Vespertilio noctivagans Leconte, Cuv. An. Kingdom (McMurtrie's ed.), I, June, 1831, 31; Cooper, Ann. Lyc., Nat. Hist. N. Y., IV, 1837, 59; De Kay, Nat. Hist. N. Y. (Zööl.), 1842, 9, Pl. I, Fig. 1; Wagner, Schreb. Säugeth., Suppl., v, 1825, 754.

Vespertilio auduboni Harlan, Month. Amer. Jour. Geol. Nat. Hist., I, 1831, 220, Pl. II; *Ib.*, Med. and Physical Researches, 1835, 30, Pl. IV.

Vespertilio pulverulentus Temminck, Monog. Mam., II, 1835, 235; Leconte, Proc. Acad. Nat. Sci. Phila., 1855, 436; Max. zu Wied, Archiv Naturg., 1861, 192.

Scotophilus noctivagans H. Allen, Monog. N. A. Bats, 1864, 39.

Lasionycteris noctivagans Peters, MB. Akad. Berlin, 1865, 648; Merriam, Mamm. Adirondack Region, 1886.

Vesperides noctivagans Coues and Yarrow, Wheeler's Exped., Zööl., 1875.

Vesperugo noctivagans Dobson, Cat. Chirop. Brit. Mus., 1878, 238.

Description—Ear oval. Internal basal lobe of dull yellow color which contrasts with the dark brown of the rest of the auricle. The free projecting lobe rather larger than in other species of the group. The lobe ends abruptly on the inner border, which is directed in an oblique straight line upward and backward to a blunt tip which is in the long axis of the auricle and is not directed backward. The upper part of the outer border is straight and bears a delicate fold which is turned back against the posterior surface of the auricle. The lower part is convex, also bears a delicate reverted fold, and is separated from the upper by a small notch. The external basal ridge does not reach the border of the auricle. It is irregular and bears two tubercles, between which lies a well defined pocket. The external basal lobe is membranous and bears upon its inner surface a small nodule which is homologous to the reverted portion in *Adelonycteris fuscus*. The external basal lobe ends on a post-rectal wart.

Thus the ear has a membranous expansion of variable width on the posterior border from the tip to the angle of the mouth.

Tragus short and blunt, straight on the inner border, slightly deflected outward at the outer border for a short distance, and is thence abruptly convex, to be gradually inclined inward at the pedicle. The outer surface of tragus is concave and suggests in a general way the plan in *Emballonura*. Glandular masses on side of snout conspicuous; they

appear to advantage against the depression in the face directly back of them. Snout is broad, scarcely emarginate. Width between nostrils greater than distance from mouth to top of snout. Upper lip slightly pendulous at the side. Mental plate well defined inferiorly. Dobson states that the inner margin of the tragus appears to be in the angle between the free projection of the internal basal lobe and the conch. This must be an individual variation or an error of observation.

Dorsum fur long and silky, of a dark brown, black at the basal two-thirds or four-fifths, the apical portion becoming abruptly gray or white. The head and neck almost entirely brown-black, the silvery appearance not being sufficient to give character to the region. Occasionally the hair of the face, both above and at the sides, will be of the dominant color, while the crown and nape will be of the same character as the body.

Below the fur is of the general character of the dorsum, but slightly shorter. The postmental region nearly naked, the rest of the neck scarcely silvery, as on the dorsum of face.

The prebrachium with distinct tendon of occipito-pollical muscle. Three conspicuous intercostal lines are discerned.

The coraco brachialis fascicles rises high up near the axilla. The triceps fascicle system with vertical oblique and horizontal lines discernible. None of the terminal lines of the foregoing, reach the free margin of the wing-membrane. No vertical lines apart from the foregoing are discernible. The obliquetibial line arises from near ankle and extends as far as the intercosto-humeral at the elbow.

A delicate forked line extends downward and somad from the lower part of muscle mass at the proximal end of the fifth metacarpal bone.

The fourth interspace exhibits the predigital nerve appearing in a well-defined elevated fold of membrane at the side of the muscle-mass just named. The line forms a curve and extends about one-half way down the shaft of the fifth metacarpal bone, when it is lost along the line of the shaft. The main branch of the nerve arises from the middle of the curve and passes downward and forward, but does not extend beyond the middle of the interspace, nor quite to its free border. The postdigital nerve arises high in the interspace, apparently from the palm, approaches the fourth metacarpal bone at its proximal end, but soon leaves it and is distributed to the anterior half of the interspace.

The third interspace shows a delicate line from the first interphalangeal joint of the fourth finger and a second longer one from the metacarpo-phalangeal joint of the third finger.

The interfemoral membrane shows the oblique line (above) as a caudotibial, since it arises from the side of first caudal vertebra. The transverse lines on the interfemora membrane are regularly disposed and marked with minute pilose warts.

The terminal phalanges much the same as in *Atalapha*. The parts are all delicate; the terminal phalanx of the third digit is sigmoid and

EXPLANATION OF PLATE XIII.

- FIG. 1. Front view of head of *Lasionycteris noctiragans*.
FIG. 2. Side view of same.
FIG. 3. View of tragus and inner surface of auricle.
FIG. 4. Wing membrane.
FIG. 5. Tail and interfemoral membrane.
FIG. 6. The skull seen from above. x 2.
FIG. 7. The skull and lower jaw seen from the side. x 2.



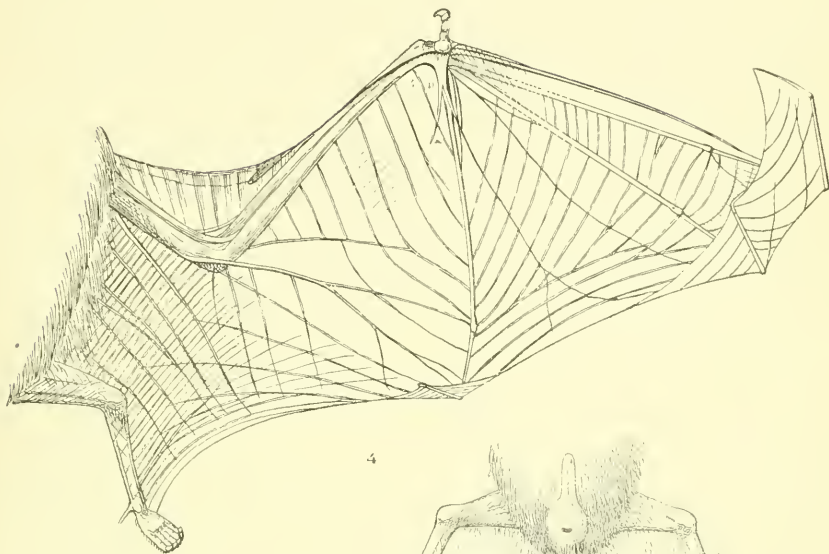
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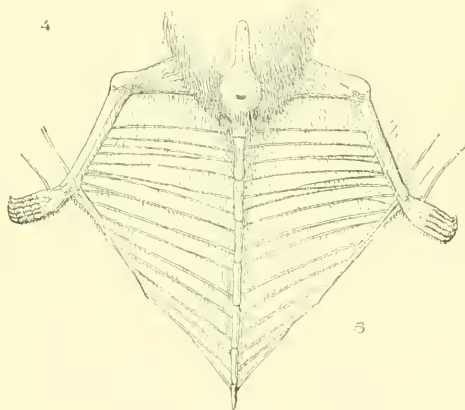
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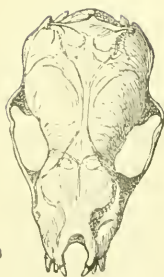
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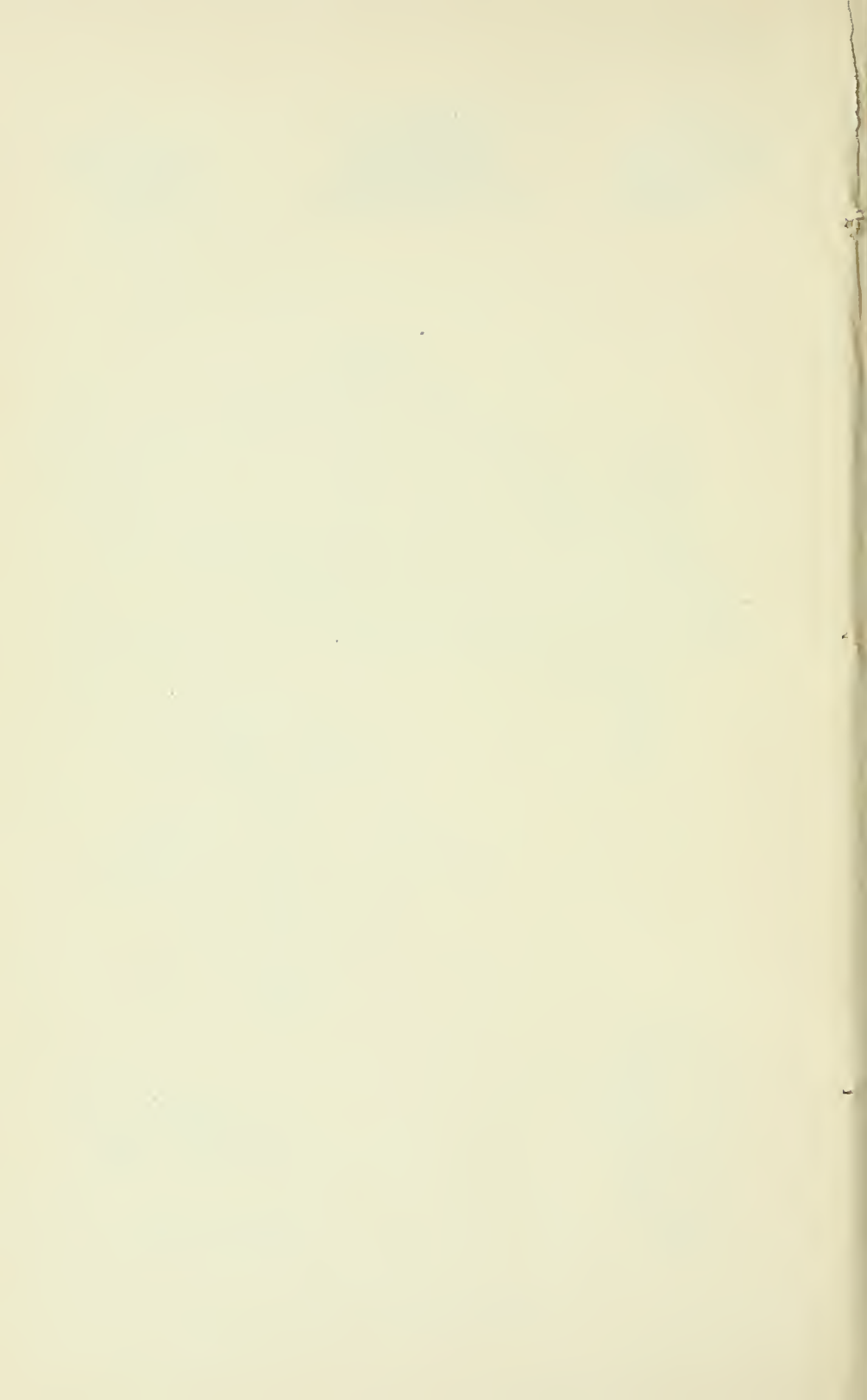


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7

LASIONYCTERIS NOCTIVAGANS.



less rigid than in any species examined. The tip of the terminal phalanx of the fourth digit is minutely lobed and free.

The dorsum of the interfemoral membrane sparsely covered with silvery tipped hair for four-fifths of its extent; the tibiae are involved.

The wing membranes are attached to the base of the toes. The fifth metacarpal bone is shorter than the third and fourth, which are of the same length. No raised lines are present in the radio-metacarpal angle or about the muscle-mass at the base of the fifth digit. A delicate raised line is seen on the dorsum of the prebrachium. The prebrachium ends at the distal third of the forearm. The distance from the end of the fifth metacarpal bone and the olecranon (the manus being closed) equals one-seventh of the length of the forearm. (In *A. fuscus* this distance equals one-ninth the length of forearm.) The fourth and fifth metacarpal bones lie well palmed of the third. (In *A. fuscus* they are on the same line.) In repose the first phalanx of the third digit is nearly in the same line with the third metacarpal bone, as in *Noctilio* and *Miniopterus*. The second phalanx of the same digit is straight.

In a specimen from Beaverton, Oregon, sent me for examination by Mr. G. S. Miller, jr., Cambridge, Mass., the tip of the calcaral spur is distinctly lobed and the foot is exactly one-fifth the length of the forearm. The membranes and hair are black.

Variations.—Variation is slight in coloration, notwithstanding the extended range of the species and the great numbers found in certain localities. Leconte describes "entirely black" examples; these I have never seen. Occasionally the dorsum, where the hair of the side of the body ends and that on the membrane begins, is marked by a conspicuous line of hair having long white tips. The basal black or brown does not always abruptly end in the tip, but an obscure, rusty-black shade intervenes. I have not met with any varieties with furred thumb. The shafts of the hair in front may be plumbeous instead of brown black. The edges of the lips, as well as the internal basal lobe, are sometimes white. Very rarely the tip of the tragus is pointed instead of blunt. The external basal lobe may extend across the post-rietal wart to the mouth. The lobe is very rarely revolute in any degree.

A specimen from Healdsburg, Cal. (Cal. Acad. of Science), appeared to be somewhat darker, both in fur and membrane, but in essential particulars it was similar to Eastern forms.

Skull.—There is no trace of a crest at the sagitta; temporal ridges are absent; the mesencephalon equals one-fourth the greatest length of the cranium; the eminence for the proencephalon minute and bears two foramina which are near each other; the vertex of the face with a low nasal eminence for the anterior one-third of the entire region; the posterior two-thirds is concave; the maxillae are deeply concave on either side of the nasal eminence.

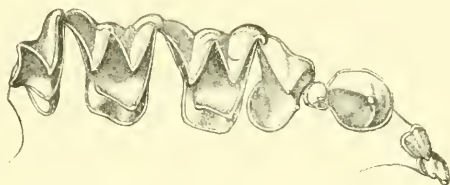
The fronto-maxillary region is produced laterally into a trenchant ridge which causes the inner wall of the orbit to appear concave. The

infraorbital foramen is small and near the orbit. In the orbit the corresponding foramen is large and without concavity about it. A line produced from the upper margin of the anterior nasal aperture intersects the dental arch directly back of the canine tooth. The upper border of the zygomatic arch elevated. The paroccipital process is produced, but does not reach the level of the lower border of the occipital condyle; it is longer than the mastoid. The region between it and the mastoid is slightly inflated with a shallow incision inferiorly; it equals one-ninth of the greatest length of the skull. The tympanic bone is not complete above, the head of the malleus, as in *A. fuscus*, appearing in the interval and without an anterior basal process.

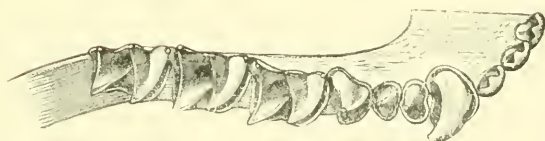
A small post maxillary process is present. Basisoccipital without lateral concave depression. The sphenoidal tongue is conspicuous, concealing the cochlea at the anterior half. The posterior palatal spine is well developed; the vomer is recedant. The height of coronoid process above level of the condyle is less than the width of the horizontal ramus. The interval between angle and condyle is rectangular. The symphysis yields a small posterior process which ends opposite the second premolar.

Examination of the interior of the nose shows that the septoturbinal space extends a little in advance of the septal line. There is but a single opening for the ectoturbinal. The main plate is marked by a relatively small opening, behind which extends a row of three small foramina. On the nasal surface the endoturbinal series is inflated, and does not exhibit the lateral concavity seen in other *Vesperitilionidae*. It is directed downward and forward. The first endoturbinal is as in *A. fuscus*. It reaches a point as far as the canine tooth, is slightly depressed above, and presents a uniformly sloping surface laterally. Its lower edge forms the lower border of the median surface. The second endoturbinal is of uniform width, longer than high, and equal in length to the free portion of the first endoturbinal. The third endoturbinal is smaller than the preceding.

Maxillary teeth.—The median of the maxillary incisors is bifid on the cutting edge, and so placed as to be obliquely lodged in the jaw, the inner of the bifid points being directed outward. The lateral incisor with a conical outer (labial) surface and a trenchant flange of nearly the same length as the median aspect of the palatal surface. These two parts are in exact antero-posterior position to each other, thus being in contrast with the oblique position of the parts in the case of the central tooth. The canine is concave on the palatal surface, the trenchant border being in the line of the tooth axis; the labial surface posteriorly is concave. The first premolar is very small, but edged in the space between the outer and inner angles of the interval between the canine and second premolar; the second premolar scarcely longer than first molar with a sharp spine-like protocone and low rounded heel; the first and second molars with posterior commissure of the protocone

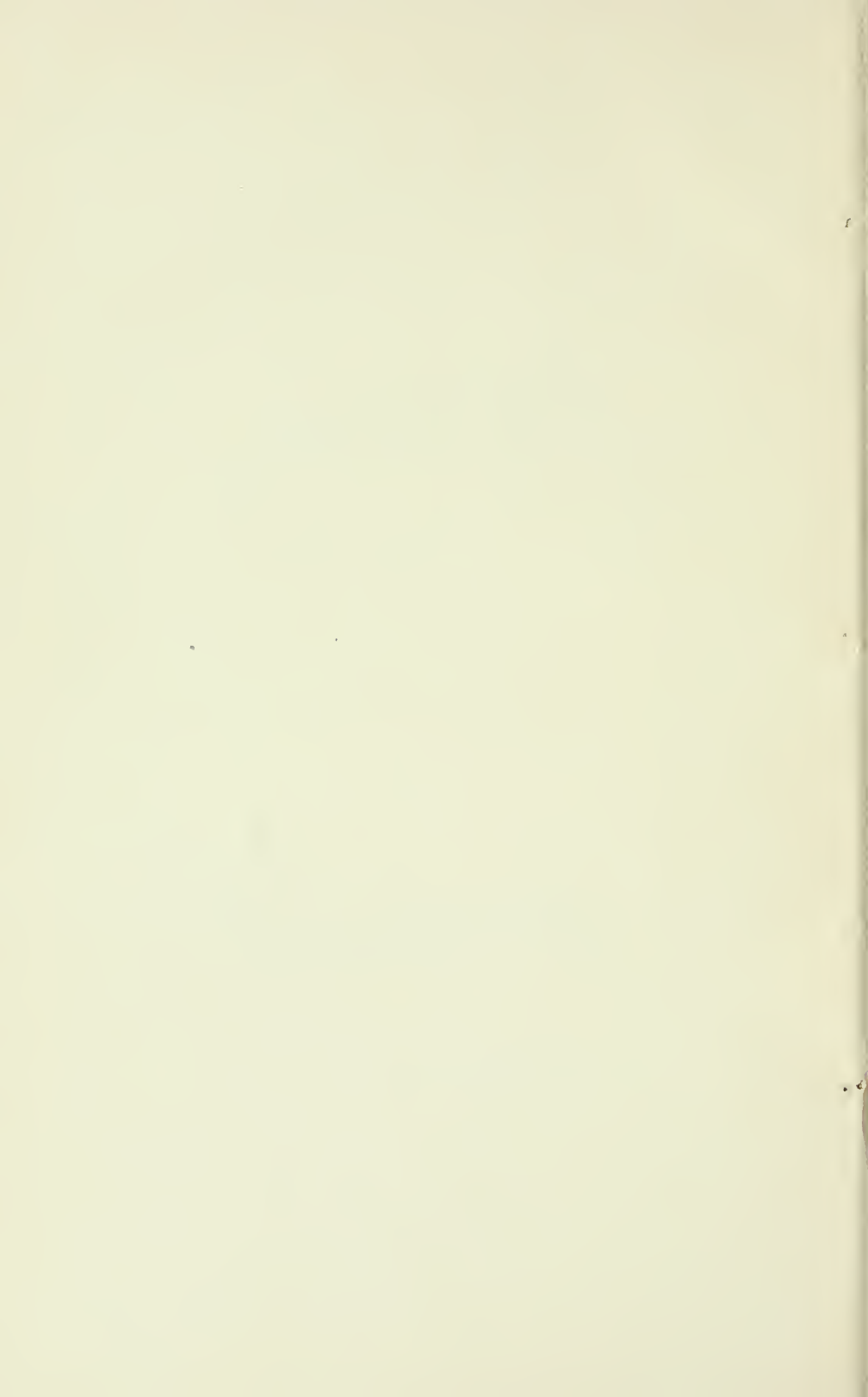


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1. MAXILLARY TEETH OF *LASONYCTERIS NOCTIVAGANS*. X 8.
2. MANDIBULAR TEETH OF SAME. X 8.



absent; the anterior V nearly of the same size as the second; the heel is rudimental, the apex is seen as on the posterior part of the cusp of the heel in fig. In the third molar the posterior commissure of the protocone is entire and adjoins against the palatal end of the anterior limb of the second V, the second limb being absent.

Mandibular teeth.—The first incisor presents a trifid cutting edge and is more inclined than the others from within outward, thus permitting much of the base to be seen when the tooth is viewed from above. The second and third teeth gradually increase in thickness, the last named having a distinct nodosity back of, but on the same level with, the trifid cutting edge. The canine is concave on its posterior border, and presents an unusually broad cingulum. Of the three premolars the first is slightly larger than the second, the third is largest of the series, and is trihedral. All are surrounded by complete cingula. The molars are quite as in *Vespertilio* distinguished by possessing high acute tips.* A minute cusp outlines the posterior border of each molar at the lingual base of the heel. In the first and second tooth the heel is larger than the V, and projects farther on the buccal side and is without a trace of a commissure. The third molar differs from the same tooth in any of the genera of the group in the triangular form of the heel, but is a little smaller than the corresponding part in the first and second molar. It also is without a commissure.

Notes on the skeleton.—Coracoid process of scapula, with base broader than the apex, which is obscurely bifid. The inferior border of the innominate bone at the ischium and pubis produced. The thyroid foramen is subrotund. Ribs, eleven in number. Ulna as in *A. fuscus*. Palatal rugæ, seven.

Remarks on sex.—No secondary sexual characters have been detected. Females are much more numerous than males in the Adirondacks. (Merriam, *l. c.*) Out of eighty-five caught in one locality, but one was a male. In collections the males are less commonly seen than the females. I have examined ten males and fifteen females. The penis is whitish, long, subcylindroid—prepuce not expanded.

Habitat.—Distributed throughout the United States. It would appear from specimens in museums to be much less common toward the Western range than in the East. At the date of the publication of the monograph it had not been found in the Rocky Mountains or in California. According to J. B. Tyrrell (Mam. of Canada, 1888), *L. noctivagus* is found as far north as Hudson Bay.

Habits.—C. Hart Merriam (*l. c.*) has given close attention to the habits of the silvery bat. In his work on the Mammals of the Adirondack Region, this writer states that *L. noctivagus* is the most common bat in that section. In one locality, out of seventy species secured sixty-three were of this species. It is the earliest species to appear, and is especially fond of water ways and the borders of hard-wood

* These are often worn off in the first and second molars in old individuals.

groves. The young were found to be more "beautiful" than the adults and alone to possess perfect silvery tips to the hairs. This fact is not borne out by my examinations. I have found less difference in the color of the young and adult than in other species, and between the half-grown and the adult forms I have observed none of the contrasts which are so noteworthy in *A. fuscus*.

Mr. Merriam states that this bat has been known after being wounded and falling into the water to swim powerfully and swiftly against a strong current to the shore. This is an interesting fact. Mere fluttering of the wings of a wounded animal could not so direct the animal. It must be that a coördinated act (presumably in imitation of the act of flight) propelled the animal through the water.

Measurements.

	U.S.N.M.* 5291. St. Louis, Mo.	Collection of G.S. Mil- ler, 1900. Beaverton, Oregon.
Head and body (from crown of head to base of tail).....	37	38
Length of arm.....	23½	23
Length of forearm.....	38	36½
First digit:		
Length of first metacarpal bone.....	1½-2	2
Length of phalanges.....	5	5½
Second digit:		
Length of second metacarpal bone.....	32	35
Length of first phalanx.....	3	4
Third digit:		
Length of third metacarpal bone.....	33	35
Length of first phalanx.....	13	14
Length of second phalanx.....	6	10½
Fourth digit:		
Length of fourth metacarpal bone.....	34	35
Length of first phalanx.....	12	14
Length of second phalanx.....	6	7
Fifth digit:		
Length of fifth metacarpal bone.....	31½	33
Length of first phalanx.....	7	10
Length of second phalanx.....	4	5
Length of head.....	17	19
Height of ear.....	9	10
Height of tragus.....	12	12
Length of thigh.....	14	13
Length of tibia.....	7	7
Length of foot.....	31	32
Length of tail.....		

*Not quite mature.

†The differences in some of the measurements of the two examples is due to the immaturity of specimen No. 5291.

Measurements from first edition of Monograph.

Current number.	From tip of nose to tail.	Length of tail.	Length of fore- arm.	Length of tibia.	Length of longest finger.	Length of thumb.	Height of ear.	Height of tragus.	Ex- panse.	Nature of speci- men.
	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	
3328.....	2.6	1.6	1.7	0.6	2.9	0.3	0.6	0.2	12.0	Dry.
4729.....	2.9	1.5	1.6	0.6	2.9	0.3	0.6	0.2½	.....	Do.
746.....	2.5	.....	1.7	0.6	2.9	0.3	0.6	0.2½	.....	Do.
74.....	2.3	1.5	1.6	0.6	2.9	0.3	0.6½	0.3	.....	Do.
2231.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	Do.
	2.0	.....	.....	0.6	.....	0.3	0.6	0.3	.....	Do.
1785.....	2.2	1.2	1.6	0.7	2.7	0.4	0.5½	0.2½	.....	Do.

List of specimens.

Cat. No.	Number of specimens.	Locality.	Presented by—	Nature of specimens.	Collection.
5331	1	James Bay, II. B.	C. Drexel	Alcoholic	U. S. Nat. Mus.
5295	2	Moose Factory, II. B.	do	do	Do.
5301	1	Middleboro, Mass.	J. W. P. Jenks	do	Do.
5427	1	Carlisle, Pa.	S. F. Baird	Dry	Do.
5305	1	do	David Miller	Alcoholic	Do.
5357	1	West Philadelphia.	W. S. Wood	do	Do.
5290	1	Mt. Holly, N. J.	Dr. Geo. C. Brown	do	Do.
5296	1	Washington, D. C.	W. Wilson	do	Do.
3328	1	Illinois River.	R. Kennicott	do	Do.
5291	1	St. Louis, Mo.	Dr. Engelmann	do	Do.
5293	2	Nebraska	Dr. J. G. Cooper	do	Do.
5294	1	Platte River	W. S. Wood	do	Do.
5431	2	Fort Union, Nebr.	Dr. F. V. Hayden	do	Do.
5359	1	do	do	do	Do.
5316	2	do	do	do	Do.
5429	1	Yellowstone River.	Col. Vaughan	do	Do.
5289	1	Puget Sound	Dr. Kennedy	do	Do.
5321	1	Fort Reading, Cal	Dr. T. F. Hammond	do	Do.
5292	1	United States.	(?)	do	Do.
4729	1	do	Maj. Leconte	do	Do.

Genus **ADELONYCTERIS** H. Allen.

Scotophilus Leach, Trans. Linn. Soc. London, XIII, 1822, 71. (Type, *S. kuhlii*.)

Vesperus * Keyserling & Blasius, Wieg. Arch. 1839, Wirbelthiere Europas, 1840, 49.

Adelonycteris H. Allen, Proc. Acad. Nat. Sci. Phila., 1892.

Diagnosis.—As in the case of *Vespertilio* it is impossible to frame a diagnosis of a genus where the forms are cosmopolitan and the student is confined to material representing a fauna. I am content to designate *Adelonycteris* by the dental formula.

Dental formula.—Molars $\frac{3}{3}$, premolars $\frac{1}{2}$, canines $\frac{1}{1}$, incisors $\frac{2}{3} \times 2 = 32$ teeth.

Vesperus was established on *Vespertilio scrotinus* and *Vespertilio discolor*. It is distinguished from other vespertilionine bats by the presence of a single molar in the upper jaw. The genus *Scotophilus* was based by Leach on an individual without locality. For many years English writers (especially Gray and Tomes) applied this name to the forms now included under *Vesperus* and *Vesperugo*. I followed the same practice in the Monograph of 1864, since I naturally assumed that these writers were acquainted with Leach's type. Peters in 1866 pointed out the fact that *Scotophilus* was distinct and embraced a group of bats none of whose representatives are found either in Europe or America. *Scotophilus*, therefore, can be no longer applied to any of our species. I have lately ascertained, through specimens in the possession of the Museum of Comparative Zoölogy, that *Scotophilus* closely resembles *Atalapha*, which genus it may be said to represent in Africa, Asia, and Australia.

Mr. F. W. True has called my attention to the fact that the *Vesperus* of Keyserling and Blasius, 1840, is antedated by *Vesperus* of Dejean, 1821. The latter was a *nomen nudum* until 1829, when it was taken

* K. & B. proposed *Vesperus* as a subgenus to *Vespertilio*.

up by Latreille and described. The *Vesperus* of K. & B. is, therefore, untenable. *Vesperus* is valid only in Latreille, 1829 (Coleoptera, Cerambycidae). Acting upon the information herein conveyed, I have proposed (*l. c.*) to change the name of *Vesperus* as applied to a genus of Chiroptera to *Adelonycteris*.

1. *Adelonycteris fuscus* (Palisot de Beauvois), The Brown Bat. (Plates xv, xvi, xvii.)

Vespertilio fuscus Palisot de Beauv., Cat. Peale's Mus., 1796, 14; Leconte, Proc. Acad. Nat. Sci. Phila., 1855, 437.

Vespertilio carolinensis Temminck, Monog. Mam., II, 1835, 237; Harlan, Fauna Amer., 1825, 9; Godman, Amer. Nat. Hist., 1826, 67; Leconte, Cuv. An. King., (McMurtrie's ed) I, 1831, 431; Harlan, Month. Amer. Jour. Geol. and Nat. Sci., I, 1831, 218; *Ib.*, Med. and Phys. Researches, 1831, 28; Cooper, Ann. Lye. Nat. Hist., N. Y., IV, 1837, 60; DeKay, Nat. Hist. N. Y., Zool., 1842, 10, Pl. II, f. 1.; Leconte, Proc. Acad. Nat. Sci. Phila., 1855, 434; Wagner, Schreb. Säugeth., Suppl., v, 1855, 753.

Vespertilio arcuatus Say, Long's Exped. Rocky Mts., 1823, 167.

Vespertilio phaiops Raf. Amer. Month. Mag., 1818, 445 (*not* Temm. Monog. Mam., II, 1835, 234); Leconte, Proc. Acad. Nat. Sci. Phila., 1855, 437; Wagner, Schreb. Säugeth., Suppl., v, 1855, 756.

Vespertilio ursinus Temminck, Monog. Mam., II, 1835, 234; Wagner, Schreb. Säugeth., v, 1855, 756; Max. zu Wied, Archiv Naturg., 1861, 190.

Vespertilio gryphus Wagner; Schreb. Säugeth., v, 1855, 749.

Vespertilio caroli Leconte (*not* Temm.), Proc. Acad. Nat. Sci. Phila., 1855, 437.

Scotophilus greeni Gray, Cat. Mam. Brit. Mus., 1842.*

Scotophilus fuscus H. Allen, Monog. N. A. Bats, 1864, 31; J. A. Allen, Bull. Mus. Comp. Zool., 1869, 208.

Vesperus serotinus var. *fuscus*, Dobson, Cat. Chirop. Brit. Mus., 1878, 193.

Vesperus serotinus Alston., Biolog. Centrali-Amer., Mam., 1879-82, 20.

Vesperus serotinus fuscus Merriam, Mammals of Adirondack Region, 1886, 184.

Diagnosis.—Scallops of auricle disposed to be revolute. Chin plate obscurely defined or triangular. Upper lip not defined—continuous with muzzle. Tragus blunt—outer border slightly convex. The median incisor bifid greatly larger than lateral coracoid. The process with small anterior spine from free end; not deflected posteriorly, but descends parallel to glenoid cavity. Dorsum of face naked; lips not whiskered.

Description.—Ears erect, but incline outward; the tip can be made to reach a point half way between the angle of the mouth and the snout. The general slope of the ear is elliptical, with the blunt tip turned slightly backward. The internal basal lobe broad rounded, but does not project back of the internal ridge; the anterior border of the ear convex, posterior emarginate and joins the region of the external ridge abruptly by a moderate first scallop, which is sometimes revolute. The external basal lobe is longer than high involute, scarcely elevated posteriorly, slightly oblique to the border of the auricle and thicker on free border than elsewhere. The second scallop occupies a triangular space and

*J. A. Allen believes that *Eptesicus melanops* Raf., belongs to this synonymy. (See Appendix.)



EXPLANATION OF PLATE XV.

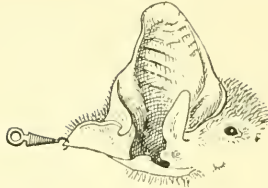
- FIG. 1. Front view of head of *Adelonycteris fuscus*.
FIG. 2. Side view of same.
FIG. 3. View of tragus and inner side of auricle.
FIG. 4. Wing membrane.
FIG. 5. Tail and interfemoral membrane.
FIG. 6. Skull seen from above. x 2.
FIG. 7. Skull and lower jaw seen from the side. x 2.
FIGS. 8-10. Maxillary incisors. x 16.



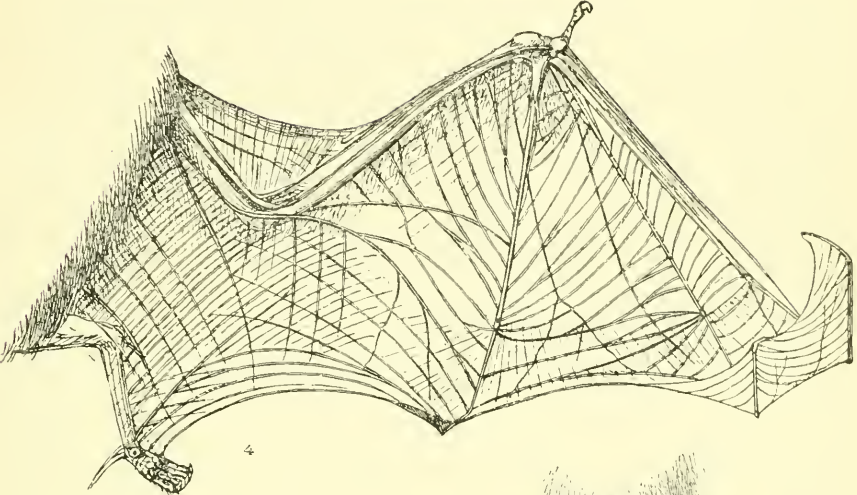
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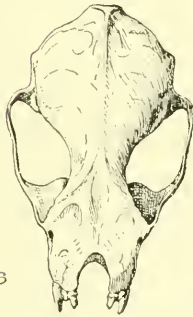
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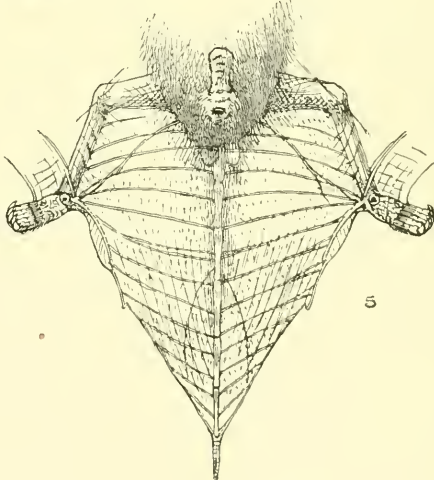
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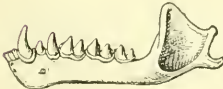
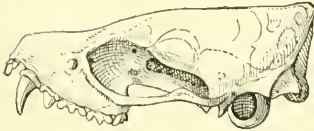
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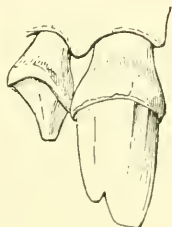
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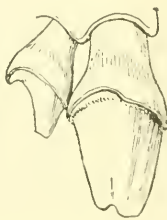
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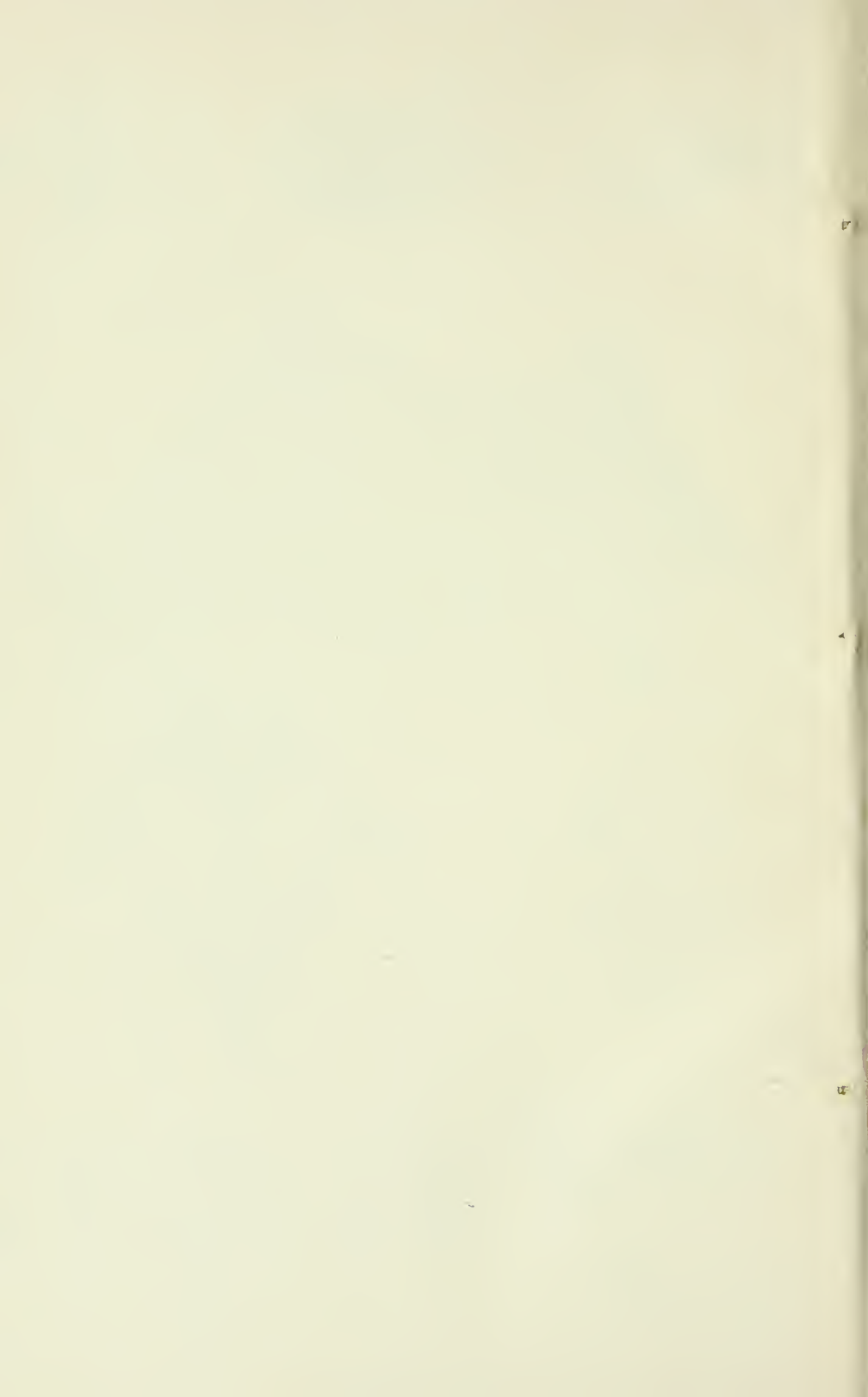
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9



10



extends well upon the lobe. The tragus is straight or slightly concave on the inner border and convex on the outer; the tip is blunt. The external basal lobe is rounded, turned slightly forward; the notch above it is narrow but sharply defined. A conspicuous postictal wart is present. The lips are fleshy and furnished above with a sparse row of coarse hair. Other than a few coarse hairs the face is naked. The snout is blunt, with scarcely any emargination between the palmate nostrils. The mental plate small, triangular, and obscurely defined. The postmental wart is commonly present.

The hair above is dark brown, or tawny, nearly black at the basal half with dark brown (olive) to lustrous isabella-brown tips. Below the colors are lighter, the general color being gray, pallid, or yellow brown. The tips of the hair on the surface last named varies greatly in tint among specimens of the same geographical range or locality. I have seen many fawn-colored individuals from the North Atlantic coast. In the neighborhood of Philadelphia specimens occur with fawn-colored tips, though the rule is for the color to be as above described. In the Western forms the tips may be obscure light buff.*

The hair extends on the membranes above from the proximal half of the humerus along the side of the body to the proximal half of the femur. With the exception of a small portion of the prebrachium as it joins the neck the wing membranes are naked, as is also the space between the caudal vertebrae and the thigh. Beneath, the hair, as is the rule in Chiroptera, covers a large surface. A sparse growth reaches from the body to a point midway to or quite to the elbow, and, by a well-defined hem, from the middle of the humerus to the middle of the femur. The upper fourth of the interfemoral membrane is slightly furred.

In 11217, adult, from Brazos, Tex., the membranes are of a brown color, the basal parts of the hair on the dorsum are light brown, while the tips are of scarcely any different shade. In the venter the hair is likewise light brown at basal half, but the remaining portion of the hair is much paler. The ears and dentition are the same as in other of the species.

In 5335, adult, from Carson Valley, Nevada, the colors are much the same as in the example last named, except that the membranes are much darker.

In 12698, adult, from Santa Barbara, Cal., the external basal lobe, without incurved upper border hem, extends upwards nearly as far as the tip and completely concealing the external emargination: three conspicuous transverse lines on the inside of the auricle. The coloration is not distinct, being quite the same as in the average example.

* "*A. fuscus* presents a wide range of apparently individual variation in color. Specimens from a single locality taken at the same season vary from a light-yellowish or golden tint to a deep sepia brown." (J. A. Allen, Bull. Am. Mus. Nat. Hist., III, 169, 1890.)

But it may be said that the Californian specimens do not, as a rule, differ from the Eastern ones. I have many examples in good condition from Mr. H. A. Ward's collection, and find them in no way atypical.

The immature examples are often more white at the tips than are the adults, and in one specimen from Williamstown, Mass. (U. S. N. M. No. 4844), is almost an albino. Other things remaining the same, the presence of the long, whitish tips to the hair prepare the student for the fact that the specimen is not fully grown. The varying degrees in which the pale shades of the tips of the hair are met in adults depend upon the extent to which the colors of the young animal are retained.

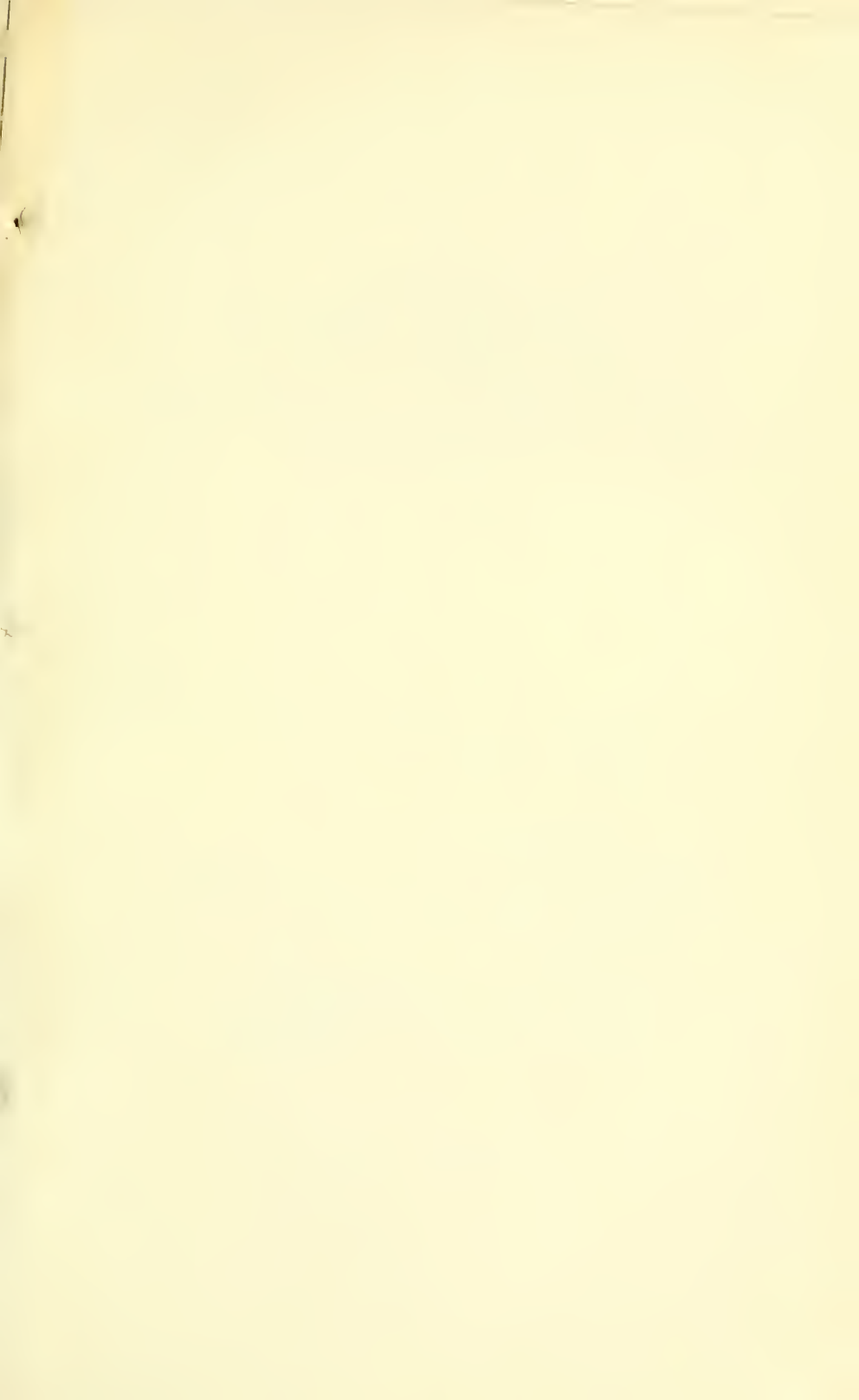
Although pertaining to forms beyond the limits prescribed in this essay, the following notes may be of interest. Mr. J. A. Allen (Bull. Am. Mus. Nat. Hist. III, No. 169, 1890), describes a specimen from Nassau, which is one-third the size of the *A. fuscus* of the United States, and has delicate membranes and ears and is similar in color. In No. 8185 U. S. N. M., from Cuba, the colors are of an almost golden brown above the basal darker colors. In all other respects the specimen is like those from which the general description is drawn up. In No. 13215, adult, from Mirador, Mexico, the shades of basal brown on the dorsum are of a very dark brown, while the tips are warm sienna. On the venter of chest and abdomen the hair is of four obscurely differentiated shades of dark brown and gray, the tips being gray. The hair on the neck is of two shades only, the basal two-thirds being light brown, and the tips being conspicuously white gray.

On fresh specimens collected in Philadelphia a sparse growth of hair was found on the ventral surface of the endopatagium, extending along the arm and forearm to near the wrist.

Membranes.—A small, oblique band is found at the muscle mass near proximal end of the fifth metacarpal bone on the mesopatagium, and one on the fourth interspace. The intercostal lines five in number. The postdigital line, as a rule, appears as one of two terminal branches, which arise from a common trunk in the angle formed by the approximation of the fourth and fifth metacarpal bones. The line may, in some instances, approach the fourth metacarpal and in some the fifth, when the arrangement resembles that of *Vesperugo carolinensis*. The predigital nerve shows the line from the muscle mass scarcely elevated. The terminal phalanx of the third finger slender, and equals two-thirds the length of the second. That of the fourth digit is L-shape.

The fifth phalanx is minute, a conspicuous accessory cartilage lies somad to it and projects slightly beyond the free margin of the endopatagium. A rounded callosity is seen at the ball of the thumb and palmar aspect of ankle. The tibial line does not reach the free margin of the endopatagium as it does in *Vespertilio*.

In the young and depilated adults a raised skin fold lies on the side of the neck in line with the prebrachium. It is defined by the occipito-pollical muscle. The occipito-pollical receives no accession from the

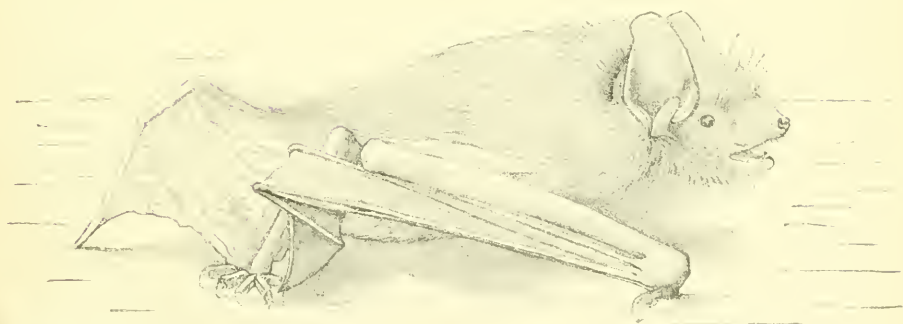


EXPLANATION OF PLATE XVI.

FIGS. 1, 2. *Adelonycteris fuscus*, showing the manner of resting. The forelimb touches the plane of support by the callosities at the base of the thumbs. The phalanges of the wing are flexed forward. The tail is arched and the tip touches the ground.

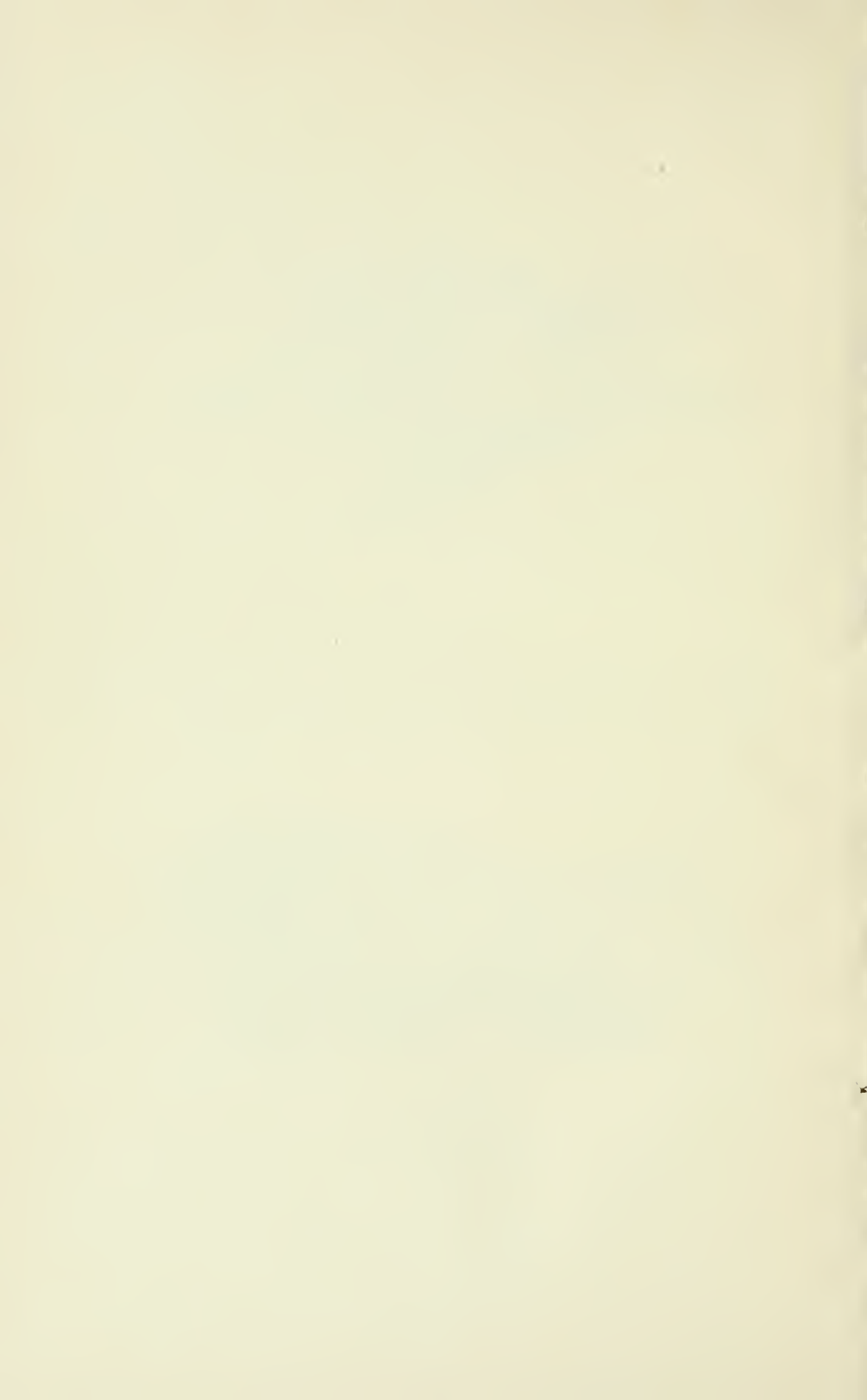


1



2

ADELONYCTERIS FUSCUS.



pectoralis. The first three joints of the tail are displayed ventrad; the remaining joints are displayed dorsad. The third metacarpal, with membrane palmar concealing contour at the proximal third. The fourth metacarpal is crossed obliquely by several nerves from the third to the fourth interspaces.

Variations.—The second scallop of the auricle may extend up a little beyond the external basal ridge along the outer border, or it may be divided into two parts by a notch at the ridge, and that portion of the hem above the notch be revolute backward and reach the curve of the tip, thus obliterating the emargination. This was well seen in an old individual in the National Museum, collected by Mr. Henshaw in the Northwest territory. The external basal lobe may not have an involute border. The tragus may be scarcely at all convex on the outer border and nearly the same width throughout. The margin of the interfemoral membrane joins the tail at the joint between the terminal and the adjoining vertebra instead of half along the last segment which is the rule. The lobe at the end of the calcar is often absent, while the post-calcaral lobe itself is rarely so. The tip of the tail in one immature specimen from Panama (3214 Cam.) was not exsert.

For variations in lengths of the metacarpal bones, see measurements.

The following notes have been taken from a number of examples collected in California. The tragus is coarsely eremulate on the outer border. The first scallop is markedly convex. The second scallop is wide and conceals the posterior third of the external basal lobe, but does not extend far up on the first scallop. The fleshy tip to the tail occupies the greater part of the exsert portion. The face, ear, and membranes are black.

In three specimens the manual formula is subject to variations. It is as follows:

	mm.	mm.	mm.
Second interspace	2	1½	2
Third interspace	8½	11	13
Fourth interspace	31	35	30
Forearm	44	42	44

Skull.—The sagittal temporal crest is well developed over the mesencephalon; of equal height with the occipital crest, the two forming a conspicuous elevation at the back of the skull. The region of the mesencephalon equals three and one-half times the length of the skull. The region of the proencephalon is flat and retains one foramen. The vertex of the face with a low nasal eminence for the anterior half. The posterior half is depressed, and is continuous with the anterior two-thirds of the sagitta. A shallow fossa is seen on the maxilla at the side of the nasal eminence. The fronto-maxillary region is moderately inflated. A distinct projecting lamina overlies the lachrymal bone. The inner wall of the orbit is nearly flat, while its upper border is inflated. The infra-orbital foramen is large, subcordate, and defined inferiorly. The depression in the region of the foramen extends be-

yond the region of the roots of the third premolar in a manner much the same as in *V. hesperus*. A distinct lachrymal canal in the orbit is seen, but no concavity lies above it. The line produced downward from the upper border of the anterior nasal aperture intersects the dental arch directly back of the canine tooth. The paroccipital process almost reaches the level of the lower border of the occipital condyle. The region between the paroccipital process and the mastoid is not elevated; it retains a deep incision inferiorly, and equals one-seventh of the greatest length of the skull.

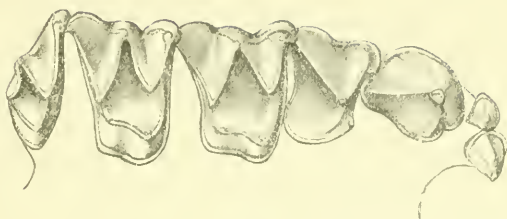
The space between the swelling over the roots of the upper incisors and canine is without groove. (See *A. serotinus*.) The upper border of the anterior nasal aperture is rounded. (See *A. serotinus*.)

There is no post-maxillary process. The tympanic bone with a small anteriorly produced process on the base. The anterior palatal notch reaches to a line intersecting the middle of the canine tooth. The height of the coronoid process above the level of the condyle greater than the width of the horizontal ramus. The interval between the angle and the condyle is semicircular. The impression for the masseter muscle is deep, and sharply defined inferiorly. Angle on line with the outer third of condyle, and is therefore scarcely deflected.

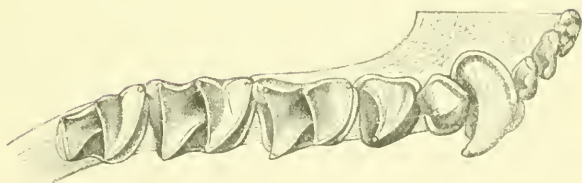
Inner ear.—Superior semicircular canal, free; the external, scarcely free; a small opening is seen in the bone almost occupying loop. A small portion of the cochlea is exposed on the side of the skull, just below the union of the occipital with the squamosal.

The openings of the septoturbinal space are confined to a large foramen, placed just in advance of the nonperforate space. Near to the septum, at the anterior portion of the space, is seen a group of foramina advancing well to the front. Directly opposite the beginning of this series, to the lateral side, is the group of foramina for the first endoturbinal plate, while in front of the latter lie two foramina for the single ectoturbinal plate. The arrangement is the same in *Vesperugo*. The ectoturbinal is as in *Noctulinia noctula*, with the exception that it is deflected a little more outward. The first endoturbinal is acuminate, with a uniformly sloping border. On the medium service the plate is not visible below the second and third plates. The second plate is as in *N. noctula*. The third is longer than wide.

Maxillary teeth.—The maxillary central incisor long, chisel-shaped, slightly inclined medianly in young and young adults, but to a less degree than in *A. serotinus*; bifid on the cutting edge, the outer nodule being larger. The cingulum narrow, uniform, entire. The lateral incisor rudimental, conical, cingulum broad, uniform, entire. The incisors exhibit considerable variation. Some of these are exhibited in accompanying figures. (Pl. xv figs. 8-10.) The modifications consist in proportion of cingulum to length of crown in the size of the small cusp on the cutting surface of the central tooth, and in the size and degree of concavity on the outer border of the lateral tooth. In one example (specimen



1



2

1. MAXILLARY TEETH OF *ADELONYCTERIS FUSCUS*. X 8.
2. MANDIBULAR TEETH OF SAME. X 8.



without locality) the central incisor was not bifid. Canine with a narrow posterior concave service; it is deflected a little outward so as to permit the flange between it and the palatal surface to lie in the axis of the tooth row. The palatal surface remarkable for a narrow column-like longitudinal ridge at the flange defining the surface anteriorly. The single premolar not distinctive; it lies in contact with the canine; in this regard it differs from the arrangement in *A. velatus*, where an interval is defined. The first molar with the first V-shaped figure is much smaller than the second; the protocone exhibits an occasional crenulated appearance posteriorly. In the second molar the V's are equal. In the third molar the protocone is simple entire, the heel absent; in this tooth the posterior limb of the first V equals one-half the length of the anterior, while the second V is represented only by the initial half of the anterior limb.

Mandibular teeth.—Incisors equal, crowded, all possessing trifid cutting edges, the third being slightly thickened, and in some individuals the trifid figure obscure. Canine with deep, broad, concave posterior surface, small lingual surface—the two being separated by a laminate flange; a prominent posterior cusp lies on the lingual side. The first premolar is smaller than the second, and is wedged in by the basal cusps of the canine and the premolar. The molars quite as in *Vespertilio*, *i. e.*, with sharply acute cusps, especially prominent hypoconid, and small cuspule in posterior borders.

Notes on the skeleton.—The coracoid process of scapula, with a small anterior spine from the free end—none from the posterior. The external tuberosity of humerus slightly higher than the internal trochlear spine; small nodular, and looks directly backward. The oblique keel on articular surface wider than the grooves. The outer groove is much the narrower and confined to anterior and axial parts, *i. e.*, is absent posteriorly. The articular surface one-third wider internally than externally. The proximal rudiment of ulna not ankylosed to the radius. The slender thread-like shaft lies against the radius at its middle, but not joined to it. It ends in fibrous tissue, and is gradually lost near the wrist. The distal ulna rudiment is quadrate and perforate. Number of ribs, eleven.

Habits and distribution.—The brown bat is probably the most common species of any in the United States. The red bat and the little brown bat appear to be numerous in collections, and are more likely to be gathered in large numbers in some localities than is the brown bat. But on the whole the brown bat is the one most generally met with. It frequents not only the open country but the towns. It often enters our apartments at night in search of a resting place, and not for food, as is often surmised. According to C. Hart Merriam (Mammals of the Adirondack Region, 1886) it is rare in the mountainous tracts of northern New York, and it is believed that the species may be, in the main, a dweller in the warmer low ranges. The highest latitude

named for it in the Monograph of 1864 was Lake Winnipeg, British America. J. J. Allen reports it from British Columbia. According to J. B. Tyrrell (Mammals of Canada, Toronto, 1888), *A. fuscus* has been collected in Ottawa City and Lake Winnipeg. Mexican and Antillean forms when compared with the more northern examples are found to be of the same species. It has been secured from all parts of the United States, but I am unable to give any rate of its distribution.

C. F. Maynard (Mammals of Florida, *l. c.*) found it frequently in the northern sections of Florida, but more abundantly in the vicinity of settlements than elsewhere. "I once captured," he states, "a female of this species which was heavy with young. I placed her in a cage and left her. After an absence of an hour or so I returned and found that she had escaped, but had left a young one clinging to the woodwork on the side. The little thing was entirely naked, but was furnished with teeth, which it showed when handled, and endeavored to bite, squeaking after the manner of all these animals. I replaced it in a cage, where it remained until night, but in the morning it was gone, and I supposed that its mother had carried it away."

The brown bat when at rest is not often found hanging by its thumbs or feet. As a rule, it rests with folded wings flat upon a rough wall or inside of a hollow tree, with its head directed downward. The following note is taken from a study of the living animal in captivity:

The tail is arched beyond the second caudal vertebra; the fleshy tip is apparently tactile, and kept close to the plane on which the animal reposes. The toes are widely abducted (see Pl. XVI). When excited the little creature emits a rapid succession of short, high-pitched sounds, at the same time opening the mouth to an extraordinary extent, exposing fleshy masses in the position of the masseter and internal pterygoid muscles. The animal is hibernating. It appears to be simply drowsy; it can be easily aroused, and the heat of an apartment at about 65° F. restores it to activity. The breathing is entirely by the flank (so far as can be observed by sight and touch), after the manner of birds. As already mentioned, the hair of the back and loin is moderately appressed and of a different luster from that of the neck and head. The animal is not sensitive to moderate sounds, but loud noises startle it when not in deep torpor from cold. A puff of air blown upon it brings it up instantly from lethargy, causing it to contract its wings to the smallest compass and open its mouth in evident agitation. The ear when touched with a probe induces the external basal ridge to be curved inward (back of tragus) and lie against the internal lobe, while the deeper parts are completely closed; the tragus is erect and its axis oblique (outward and upward) to the axis of the auricle.

Fat is stored up in this species (probably likewise in others) in two large coarsely lobate masses between the scapulæ, in the recesses between them and the head, and about the pubis. In the latter locality it is oily and less compact than is seen elsewhere.

Note on *Adelonycteris serotinus*.—Dobson (*l.c.*) includes *A. fuscus* under *A. serotinus* Schreb. In his judgment it should constitute but a variety of the Old World species. "It differs," says this observer, "from European forms of *V. serotinus* and from those from Central America in being smaller, the forearm apparently never exceeding 1".8 and the foot 0".4; also in the somewhat deeper emargination in the upper half of the outer margin of the ear." He follows these remarks with a table of measurements of specimens from North America and Cuba. C. Hart Merriam (Mammals of the Adirondack Region, 1886), follows Dobson and designates *A. fuscus*, under the rules of the Nattall Ornithological Club, as a geographical variety, viz, the *V. serotinus fuscus*. I have examined two adults and three immature specimens of *A. serotinus* (National Museum) in the preparation of this revision, and hold to the opinion expressed in the Monograph of 1864, that it is distinct from *A. fuscus*.

In this connection the following description of *A. serotinus* is presented:

Hair everywhere, both on dorsum and venter, nearly unicolored; the base and greater part of the shaft is of a dull brown, the tips slightly lighter. The light shade is more marked on the venter than on the dorsum. The young are much lighter, and present a distinctly pallid appearance everywhere. The color of the tips of the hair of the dorsum is lighter than that of the shafts.

The hair on the membranes in both adult and young as in *A. fuscus*, except that a sparse growth of pallid hair extends on dorsum of the interfemoral membrane between the tail vertebrae and the thigh. This space is naked in *A. fuscus*.

Skull.—The lachrymal swelling on the orbit is convex; seen from above it is much more prominent than in *A. fuscus*, while the process over the lachrymal is much less trenchant. The sagittal crest at the occiput is stouter. A conspicuous groove lies on maxilla between the swelling over the roots of the canines and incisors.

Teeth.—The lateral maxillary incisor is convex on outer border instead of being concave. I have seen but one exception to this in *A. serotinus*; in *A. fuscus* it is the rule. The median maxillary incisors are sharply inclined toward each other. The anterior nasal aperture is acuminate above. The lower incisors are more crowded than in *A. fuscus*; the outer tooth is in contact with the canine by a broad surface. The hypocone of the last molar is quadrate.

In *A. fuscus* the palatal rugae are seven in number. The first lies directly back of the incisors and is entire. The second and third are simple, and as a rule lie straight across the palate and are arranged in double crescents at irregular intervals, *i. e.*, the spaces between them are equal. In *A. serotinus* the palatal rugae are also seven in number. The first is interrupted in the center. The second is sinuate instead of straight as in *A. fuscus*. The remaining are arranged in crescents at

equal distances apart. In a half-grown example the rugæ are throughout arranged in crescents. I place but little reliance, however, upon the characters derived from the rugæ.

Measurements.

[U. S. N. M., 11217. ♀. Brazos, Tex.]

	Millimeters.
Head and body (from crown of head to base of tail).....	52
Length of arm.....	29
Length of forearm.....	47
First digit:	
Length of first metacarpal bone.....	4
Length of phalanges.....	5
Second digit:	
Length of second metacarpal bone.....	41
Length of first phalanx.....	4
Third digit:	
Length of third metacarpal bone.....	42
Length of first phalanx.....	16
Length of second phalanx.....	13
Fourth digit:	
Length of fourth metacarpal bone.....	41
Length of first phalanx.....	14
Length of second phalanx.....	9
Fifth digit:	
Length of fifth metacarpal bone.....	41½
Length of first phalanx.....	10
Length of second phalanx.....	6
Length of head.....	12
Height of ear.....	14
Height of tragus.....	7
Length of thigh.....	18
Length of tibia.....	18
Length of foot.....	9
Length of tail.....	46

Measurements from first edition of Monograph.

Current number.	From tip of nose to tail.	Length of tail.	Length of forearm.	Length of tibia.	Length of longest finger.	Length of thumb.	Height of ear.	Height of tragus.	Expanse.	Nature of specimen.
	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	
4731.....	2.6	1.4	1.9	0.9	2.9	0.3	0.5	0.2½	10.0	Dry.
4734.....	2.9	1.5	1.9	0.9	3.0	0.5	0.6	0.3	11.0	Do.
4737.....	2.5	1.5	1.8	0.8	3.0	0.4	0.5	0.2½	10.0	Do.
4739.....	2.9	1.4	1.8	0.9	3.0	0.4	0.7	0.3	10.6½	Do.
473.....	2.6	1.4	1.6	0.7	3.0	0.4	0.5	0.3	(?)	Do.
(?).....	2.7	1.5	1.7	0.8	3.0	0.4	0.5	0.3	11.0	Do.
3137.....	2.2	1.6	1.9	0.7	3.0	0.4	0.5	0.3	9.6	Do.
537.....	2.4	1.4	1.6	0.7	2.6	0.3	0.5	0.2½	(?)	Do.
424.....	3.0	1.4	2.9	0.8	3.0	0.4	0.6	0.3	10	Do.

List of specimens.

Catalogue number.	Number of specimens.	Locality.	Presented by—	Nature of specimen.	Collection.
6192.....	1	Lake Winnipeg.....	R. Kennicott.....	Alcoholic.....	U.S. National Museum.
5396.....	2	Williamstown, Mass.....	S. H. Scudder.....	do.....	Do.
5302.....	1	Westport, N. Y.....	S. F. Baird.....	do.....	Do.
5304.....	1	Carlisle, Pa.....	do.....	do.....	Do.
5307.....	1	Washington, D. C.....	Col. Weaver.....	do.....	Do.
5381.....	1	do.....	T. R. Peale.....	do.....	Do.
5306.....	1	Cleveland, Ohio.....	Dr. Kirtland.....	do.....	Do.
5309.....	1	Mississippi.....	Col. Wailes.....	do.....	Do.
5310.....	1	Roane County, Tenn.....	Prof. Mitchell.....	do.....	Do.
5332.....	3	Grand Coteau, La.....	St. Charles College.....	do.....	Do.
5311.....	1	St. Louis, Mo.....	Dr. Geo. Engelmann.....	do.....	Do.
5324.....	1	Fort Riley, Kans.....	Henry Brandt.....	do.....	Do.
5328.....	7	Nebraska.....	Dr. J. G. Cooper.....	do.....	Do.
5315.....	1	Milk River, Nebr.....	Dr. Hayden.....	do.....	Do.
5317.....	2	Fort Pierre, Nebr.....	Dr. J. Evans.....	do.....	Do.
5309.....	1	Fort Towson, Ark.....	Dr. Edwards.....	do.....	Do.
5308.....	1	Fort Smith, Ark.....	Dr. Shumard.....	do.....	Do.
3271.....	1	Mouth of Potomac River.....	do.....	do.....	Do.
6191 var.....	1	Brazos River, Texas.....	do.....	do.....	Do.
5320.....	1	Puget Sound, Washington.....	(?).....	do.....	Do.
5325.....	1	Carson Valley, Nevada.....	Capt. J. H. Simpson.....	do.....	Do.
5326.....	1	San Francisco, Cal.....	H. B. Mollhausen.....	do.....	Do.
5514.....	1	Posa Creek, California.....	Dr. Heermann.....	do.....	Do.
4337.....	1	United States.....	Maj. Leconte.....	do.....	Do.
4731.....	1	do.....	do.....	do.....	Do.
4739.....	1	do.....	do.....	do.....	Do.
4734.....	1	do.....	do.....	do.....	Do.
5330.....	1	do.....	(?).....	do.....	Do.
5344-5.....	2	do.....	(?).....	do.....	Do.
5411.....	1	El Mirador, near Vera Cruz, Mexico.....	Dr. C. Sartorius.....	do.....	Do.

Genus **VESPERUGO** Keyserling and Blasius.

Dental formula.—Molars $\frac{3}{3}$, premolars $\frac{2}{2}$, caninus $\frac{1}{1}$, incisors $\frac{2}{3} \times 2 = 34$ teeth.

The subgenus *Vesperugo* was established in 1839, by Keyserling and Blasius (Wiegmann's Archiv, 1839, 312; Wirbelthiere Europe as 1840).

It is characterized by the possession of two premolars in both the upper and the lower jaw.* It resembles *Adelonycteris* in the naked face and absence of whiskered lips.

For remarks on the separation of this genus from *Scotophilus*, see *Adelonycteris*.

1. *Vesperugo carolinensis* (Geoff). The Carolina Bat. (Plates XVIII, XIX.)

Vespertilio carolinensis Geoff. Annal. du Mus., Paris, 1806, VIII, p. 193; Desmarest, Mammalogie, 1820, 136 (not Temminck; see *Adelonycteris*).

Vespertilio georgianus Fr. Cuv., Annal. du Mus., Paris, 1832, 16; Leconte, Proc. Acad. Nat. Sci. Phila., 1855, 436; Wagner, Schreb. Säugth., v, 1855, 750.

Vespertilio monticola Bachman, Proc. Acad. Nat. Sci. Phila., 1841, 92.

Vespertilio crassus (?), Fr. Cuv., Annal. du Mus., Paris, 1832, 17.

Vespertilio salarii (?), Fr. Cuv., Annal. du Mus., Paris, 1832, 17.

Scotophilus georgianus H. Allen, Monog. N. A. Bats, 1864, 35.

Vesperugo georgianus Dobson, Cat. Chirop. Brit. Mus., 1878, 235.

Vespertilio erythrodyctylus (?), Temminck, Monog. Mam., 1835, II, 237.

In the opinion of Mr. J. A. Allen (Mam. of Massachusetts), *V. georgianus* of Fr. Cuvier is the same as *Vespertilio subulatus* (*V. gryphus*). The

* I exclude *Noctulinia noctula* and *Vesperugo leisleri*. See Proc. U.S. Nat. Mus., 1893, 30.

acceptance of this conclusion would leave the species which is here described unnamed. Unfortunately no one can definitely tell what the *Vespertilio georgianus* really is, if we put aside the testimony of Major Leconte, who sent the original material to Fr. Cuvier for study (*Vide* Monograph of 1864, p. 37).

This species was named *Scotophilus georgianus* in the first edition of this Monograph. The assignment to *Scotophilus* has been explained on page 111. The specific name was derived from the paper of Maj. Leconte, in which it was claimed that while the number of the teeth was that characteristic of *Vespertilio*, the back was described in the following language: "Dark plumbeous above tipped with bright rufous, the hair so arranged that the pelage appears varied with black, particularly on the upper part of the back." No other bat than the one under discussion has fur so colored; so it is evident that some other species than a member of the genus *Vespertilio* was intended. The statement regarding the teeth was erroneous. I was favored with an opportunity of examining a collection of bats which had been named by Maj. Leconte, and the bat identified by me at the time of writing the monograph as *Scotophilus georgianus*, is undoubtedly the same as the one named *Vespertilio georgianus* by Maj. Leconte.

The following passage from the Monograph is apropos to the present statement:

This species has been but imperfectly described by the authors above cited. Fr. Cuvier's diagnosis is quite incomplete, and would be undistinguishable from that of the smaller form of *V. gryphus* had it not been that, from having sent the author the specimen from which the description was taken, Maj. Leconte was familiar with the type, and afterwards gave a more exact description of the animal in the work above cited. He, however, was himself in error in some particulars, especially in making the dentition similar to that of *V. subulatus* (*V. gryphus*), and in asserting that the last false molar of the upper jaw was bi-emarginated. I have before me a large series of specimens, some of which have Maj. Leconte's name attached, but in none of them have I found any internal basal bi-emarginate cusp as described by him.

Dr. Bachman's description of *V. monticola* applies well to *S. georgianus*, excepting in the measurements, which, in the case of the ear and tragus, are entirely too small in proportion to the size of the body. I have an alcoholic specimen, marked *V. monticola*, in the same handwriting as some other specimens purported to have been labeled by Dr. Bachman, which is beyond doubt *S. georgianus* (*V. georgianus*), the ear and tragus being of the usual size.

Vespertilio carolinensis Geoff. (*Annales du Muséum*, 1806, VIII, fig., pl. 48) is figured as having two premolars in the upper jaw. Temminck (*Mammalogie*) gives five molars in each jaw. This fact would separate the species from *Vespertilio* and place it in *Vesperugo*. The figure of the head (Fig. 1, pl. 59) is quite compatible with that of *Vesperugo*. Geoffroy (*l. c.*) and Desmarest (*Mammalogie*, 1820, 136), however, both speak of its resemblance to *V. murinus*. The writer last named also speaks of its resembling *V. becksteini*, Leisler, a species not known when Geoffroy framed his description.

Temminck, for some reason not given, claims that his *Vespertilio carolinensis* resembles *V. serotinus*, and thus indicates its relation to the

EXPLANATION OF PLATE XVIII.

FIG. 1. Front view of head of *Vesperugo carolinensis*.

FIG. 2. Side view of same.

FIG. 3. View of tragus and inner surface of auricle.

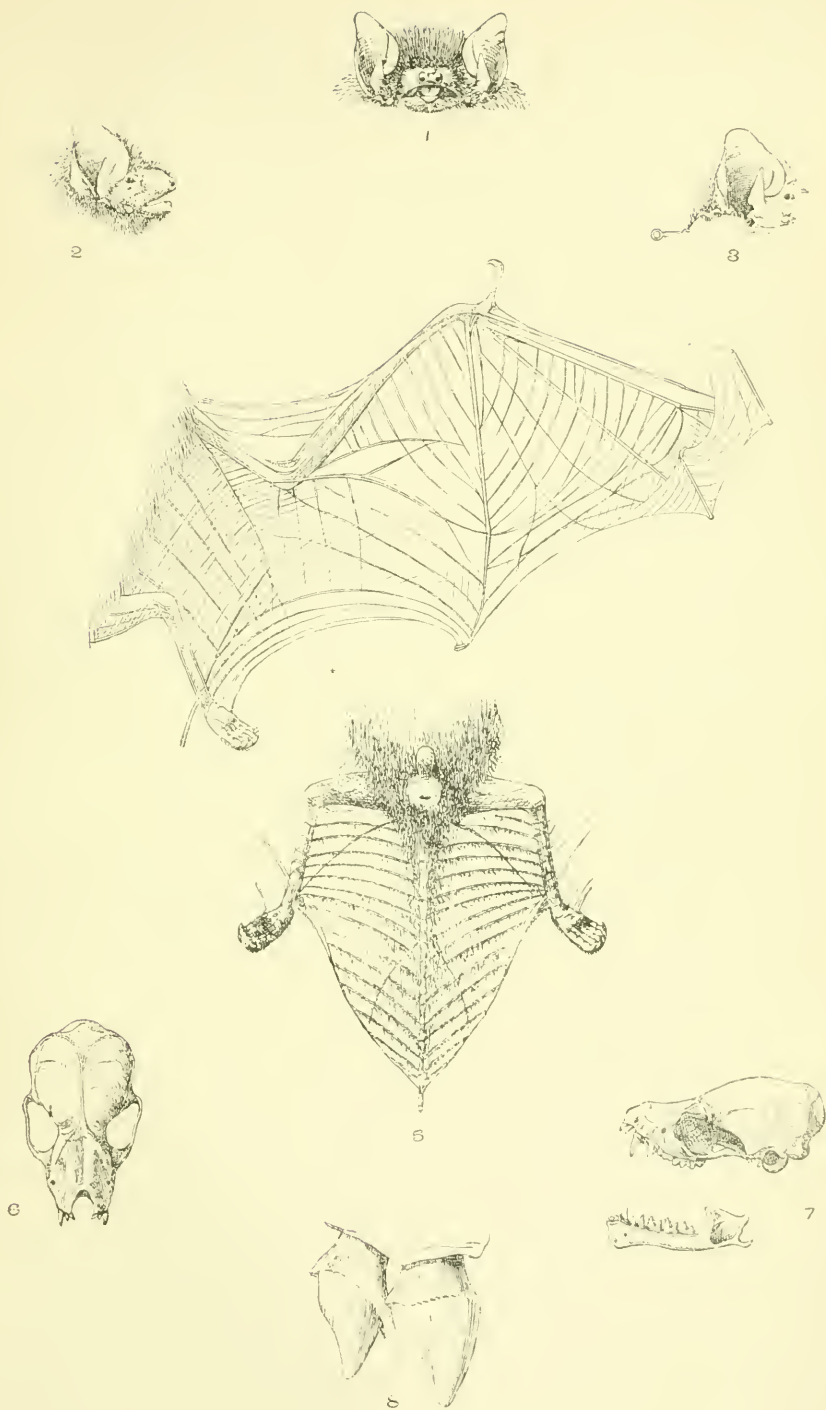
FIG. 4. Wing membrane.

FIG. 5. Tail and interfemoral membrane.

FIG. 6. Skull seen from above. x 2.

FIG. 7. Skull and lower jaw seen from the side. x 2.

FIG. 8. Maxillary incisors. x 28.



VESPERUGO CAROLINENSIS



genus which in this essay will receive the name of *Adelonycteris*. But Temminck's figure does not harmonize with his statement; the arrangement of the digital nerves in the fourth interspace of the wing membrane being precisely that of *Vespertilio*; the lips are whiskered, the tragus erect and subulate as in the American species. Nevertheless Temminck was followed by Maj. Leconte, myself, and Dobson; and so it came about that *Vespertilio carolinensis* Geoff. up to the date of the present writing has been considered to be not a species of *Vespertilio* but one of the genus having less than three premolars in each jaw. It is evident that these statements are less substantiated by facts than are those of Geoffroy and Desmarest. Unfortunately the skull as figured by Geoffroy is that of a vesperugan species, while his description is of a vespertilionine species. Can we conclude that the correct figure is drawn, and that both Geoffroy and Desmarest were in error in claiming that a resemblance exists between *V. carolinensis* and a species of *Vespertilio*? I think the conclusion last drawn is the correct one, and I infer that a bat with two premolars in the upper jaw was known to Geoffroy inhabiting the United States near Charlestown, S. C. This being assumed I note that the tragus, while of the same shape and relative size as in *V. murinus*, is yet half heart shape (demi-cœur), which, while not accurate for a North American *Vesperugo*, is not directly misleading. The tips of the hair of the belly are certainly yellow, and *V. georgianus* of Leconte is the only one in which they are so. The face is also shorter and relatively broader than in *V. murinus*. So serious is the discrepancy between the description of *V. carolinensis* of Temminck and his figure that his account must be put aside.

I conclude that the *Vespertilio georgianus* of Maj. Leconte, *Scotophilus georgianus*, of my Monograph of 1864, and the *Vesperugo georgianus* of subsequent writers, must be considered synonyms of *Vespertilio carolinensis* Geoff., and that the name *georgianus* Fr. Cuvier must be put aside and that of *carolinensis* substituted therefor.

Concerning *Vespertilio erythroductylus* Temminck, it may be said that while one false molar only is stated to be in the upper jaw, the entire number of molars is given as five. The membranes are black, but the base of the fingers and the "interdigital membrane of the first finger" are red. The tragus is subulate (en feule de saule); the fur is light red brown above (base of tail well covered), lighter shades of the same predominating below. Length of head body, 1'.6''' to 2'''; tail, 1'.4''; forearm, 1''.2'''; expanse, 7''.6''' to 8. The specimens upon which the above description is based were collected in the neighborhood of Philadelphia. On the whole, *V. erythroductylus*, other than in the red color of the base of the fingers and the length of the forearm, bears a close resemblance to *Vesperugo carolinensis*. It is well to state that Maj. Leconte (*l. c.*) has failed to identify *V. erythroductylus*.

Diagnosis.—Membranes of a dark brown color; hair chestnut brown mixed with paler shades; the thigh is hairy throughout; the ear is as

long or slightly longer than the head; second interspace without pigment. Predigital line absent in fourth interspace, as a rule. The nerve may arise from angle as in *A. fuscus*. Very rarely on one side only is the arrangement as in *Vespertilio*. Transverse lines of the interfemoral membrane numerous, regular, furnished with minute dots which are hairy. Post-calcaral lobe absent. Foot one-fourth the length of the forearm. Tip of coracoid furnished with two coequal processes.

Description.—Ear oval with slightly convex anterior sinuate, or straight outer border and blunt tip. The internal basal lobe much longer than high, as in *Adelonycteris*. The external basal lobe begins at the pilose post-rietal wart as a low skin-fold. Gradually it becomes higher, and at the posterior half is a thickened nodule with an inclination to incurve on the concavity of the auricle. The second scallop (hem) is larger than the external basal lobe. The external basal ridge ends on the border of the ear in a thickened convex border (first scallop) which extends one-half the height of the ear. It is followed by a shallow emargination, above which underlies the blunt tip. The tragus is erect, with blunt tip and straight inner border. The outer border is wider just above the well-defined notch than elsewhere and is slightly convex. The basal lobe is rounded and diverted forward.

The face more hairy than in *A. fuscus* and less blunt at the snout, which is scarcely, if at all, concave on the outer border. (No. 6088 U. S. N. M.) The fur of the back dark brown, almost black at basal half, apical half abruptly contrasted to base as being pallid, dull yellow, or light chestnut, the last-named hue predominating, the extreme tip again darker sienna, though of lighter shade than the base. The fur of the venter the same as that of the back; but without dark tips. A harmony exists between the colors of the two sides; thus, when the back is dull yellow the venter is of the same color, and so for each of the shades; the hair on the membranes unicolorous. In specimen No. 4979 S. I., Woburn, Mass., the dark tip to the fur, especially on the dorsum, was so long as to give a somber cast to the entire pelage. In new examples from Bee County, Tex. (Nos. 3482 and 3483, Am. Mus.), this characteristic was particularly well marked and suggested the style of coloration seen in *Atalapha*. The hair on the membrane on the dorsal aspect covered the proximal third of the arm, and extended thence on the membrane outward to a line answering to the knee; hence the membrane is curved for a greater distance than would be indicated by the extent to which the humerus is covered. The species is distinctive in the entire thigh being hairy. The interfemoral membrane is hairy at its basal half and of a uniform iron-rust hue. The haired surface includes the proximal half of the tibia.

On the ventral aspect the membranes are furred at the proximal third of the humerus, and thence as a sparse thin growth in the interval between the elbow and the knee. The interfemoral membrane is heavily furred below the pubis, and very sparsely so on the transverse

lines for nearly its entire extent. Specimen No. 5985 S. I., Carlisle, Pa., retains scarcely any basal or apical brown on the dorsum, the hair is of an obscure pallid hue, while beneath a rich chestnut color predominates.

A young specimen which measured 30^{mm} from crown of head to the pubis possessed short unicolored hair throughout. On the dorsum the hair was light rufus brown. On the venter the color was more obscure. The left side of the neck and body was old gold, while the right side was the color of the rest of the venter. The hair on the front of the neck was not smooth, but presented the appearance of a ruffle or irregular roussette. On the membranes the hair distribution was the same as in the adult, excepting that the dorsum of the interfemoral membrane was furred to a line above the ankles.

Variations.—The ear may be slightly longer than the head. Variations in the arrangement of the nerves of the fourth digital interspace are noted in the diagnosis.

The membranes.—*V. carolinensis* is remarkable for the absence of pigment from the second digital interspace. The wing membrane is attached to the foot at the base of the toes. The tip of the tail is exsert from an ample interfemoral membrane, whose free border is slightly convex. The calcar ends without marginal tip; there is no post calcaral lobe. The bodies of the caudal vertebræ are all dorsal; the upper part of the interfemoral membrane is not furnished with transverse muscle fibers.

Intercostals are three in number. Coraco-brachialis fascicle from the axilla. The fourth interspace with two long conspicuous predigitals, but, as a rule, no postdigital. The third interspace with the nerves from the metacarpo-phalangeal joints. In a few specimens the two postdigitals arise from a common line which extends parallel to the fifth metacarpal bone, in which case a close resemblance to some forms of *Adelonycteris fuscus* is seen. The terminal phalanx of the fourth finger as in *L. noctivagus*.

The interfemoral membrane is marked by a number of delicate transverse, slightly pilose lines, which can be traced upward as far as the second caudal vertebra. The pilose spots are conspicuous on these lines, as well as on those of the endopatagium near the body. The terminal cartilage of the fourth digit is directed pollical.

*Maxillary teeth.**—The central incisor bifid (rarely monocuspid); a thin lamina terminates the tooth posteriorly. The lateral is smaller, with a thin transverse lamina on either side of the single cusp. An interval between the lateral and the canine. The canine as in *A. fuscus*, i. e., the posterior surface deflected outward beyond the axis of the den

*Maj. Leconte (l. c.) notes the following: "Posterior false molar of the upper jaw has an interior basil, biemarginate cusp formed from a prolongation of the calcanem of the tooth, and the canine of the lower jaw has an interior, blunt, basal lobe." I have not recognized the peculiarities here noted.

tal line, the palatal separated from the posterior by a prominent flange. The first premolar is less than half the size of the second. It is in the dental line, but, owing to its minuteness, it appears to be depressed when seen in profile. Molars with well-defined cingula; first and second molars as in *A. fuscus*, except that no trace of heel is seen. The third molar with outer surface more deeply fluted than in *A. fuscus* and the rudiment of the second V-shaped figure is longer.

Mandibular teeth.—None of the teeth crowded. This remark is especially applicable to the incisors and premolars. Incisors arranged in a V-shape row, flat, trifid, first and second touching, but the third separate from the second and the canine. Canine not curved backward, presenting nowhere a concave surface. Very prominent flange between the posterior and lingual surfaces. Cingulum prominent, forming two cingules, one anterior—the larger—and one posterior (talon?). First premolar small, with entire robust cingulum scarcely touching canine. Molars quite as in *Vespertilio* and allies. Very high cusp points and pointed apex, which is subequal with V.

Variations.—In specimen the upper central incisor was bicuspid.

Skull.—The mesencephalon is 2^{mm}; the length of skull, 13^{mm}; the greatest width, 7^{mm}; the least width, 3^{mm}. The posterior temporal crests are apparently absent. The sagittal is faintly expressed; it is not visible beyond the middle of the vertex. The anterior temporal impressions are defined. The nasal eminence is absent. The entire region depressed with a linear ridge on either side. The fronto-maxillary inflation is conspicuous above the orbit, forming a bold oblique ridge, which is considerably raised above the level of the nasal bones. Both lachrymal and infraorbital foramina conspicuous. A line from the upper border of the anterior nasal aperture falls directly back of the canine. The paroccipital process is small rounded, and not produced below the level of the paroccipital. The intermediate space is incised below. The lingual tongue reaches the tympanic bone; the tympanic bone is incomplete above. The pterygoid process is furnished with a rather long style. The masseteric impression reaches the lower border of the horizontal ramus. The angle produced beyond the condyle and deflected outward so as to intersect the outer edge of the condyle. In a specimen from Carlisle, Pa., having unicuspid maxillary incisor the temporal crest is absent, and the two sagittal temporal impressions do not meet, at the same time that the post-temporal crests are more marked than in most specimens. The mandible is disposed to be entire, *i. e.*, the halves do not fall apart as readily as in other species.

Notes on the Skeleton.—Coracoid process of scapula, broader at base than at the free end, which is furnished with two coequal processes. Glenoid region with large concavity on the outer surface. Humerus so similar to that of *V. vesperus* that with the exception of size (it is 21^{mm} long) the two might be of the same species. Proximal rudiment



1



2

1. MAXILLARY TEETH OF *VESPERUGO CAROLINENSIS*. X 12.
2. MANDIBULAR TEETH OF SAME. X 12.

of ulna not anchylosed to radius. The long thread representing the shaft appears to join the radius at the distal third; it is more fixed than in *Vesperus*. The distal rudiment oblique proximal and concave outer border (perforate?). The ribs are eleven in number. The pectineal spine of the innominate bone small, little more than a nodule. The thyroid foramen elliptical. The tuberosity of the ischium not prolonged. The posterior border of the innominate bone oblique. The cavity of the pelvis narrowed from side to side. Fibula as long as the tibia.

Habitat.—The Austroriparian region, and extending thence to the north as far as Carlisle, Pa., and to the west to eastern Missouri. Nothing is known of its habits. It is often found in collections associated with *Vespertilio gryphus*, but it is not known to be collected in the same locality with this species.

Measurements.

[Mus. Comp. Zool. 5992 ♀, Short Cave, Ky.]

	Millimeters.
Head and body (from crown of head to base of tail).....	26
Length of arm.....	21
Length of forearm.....	31
First digit:	
Length of first metacarpal bone.....	2
Length of phalanges.....	6
Second digit:	
Length of second metacarpal bone.....	29½
Length of first phalanx.....	2½
Third digit:	
Length of third metacarpal bone.....	30
Length of first phalanx.....	12
Length of second phalanx.....	11
Fourth digit:	
Length of fourth metacarpal bone.....	21
Length of first phalanx.....	11
Length of second phalanx.....	6½
Fifth digit:	
Length of fifth metacarpal bone.....	29
Length of first phalanx.....	8
Length of second phalanx.....	4
Length of head.....	14
Height of ear.....	10
Height of tragus.....	4½
Length of thigh.....	13½
Length of tibia.....	14
Length of foot.....	6
Length of tail.....	22

Measurements from first edition of Monograph.

Current number.	From tip of nose to tail.	Length of tail.	Length of forearm.	Length of tibia.	Length of longest finger.	Length of thumb.	Height of ear.	Height of tragus.	Expanse.	Nature of specimen.
	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	
5298.....	1.8	1.6	1.4	0.6	2.4	0.4	0.5	0.3	9.0	Alcoholic.
5297.....	1.6	1.6	1.4	0.6	2.4	0.4	0.5	0.3	8.9	Do.
5981.....	1.6	1.6	1.4	0.6	2.3	0.4	0.7	0.3½	8.6	Do.
5982.....	1.6	1.5	1.4	0.6	2.3	0.4	0.6	0.3	8.6	Do.
5983.....	1.6	1.5	1.4	0.7	2.2	0.4	0.5	0.3	8.6	Do.
5318.....	1.6	1.6	1.4	0.7	2.3	0.4	0.5	0.3	9.0	Do.
5339.....	1.8	1.6	1.3	0.6	2.3	0.4	0.4½	0.3	9.3	Do.
5340.....	1.6	1.5	1.4	0.6	2.2	0.3	0.5	0.3	9.3	Do.
5341.....	1.6	1.6	1.3	0.6	2.2	0.3½	0.5	0.3	8.11	Do.
5341.....	1.6	1.6	1.3	0.7	2.2	0.4½	0.5	0.3	8.10	Do.

List of specimens.

Catalogue number.	No. of specimens.	Locality.	Presented by—	Nature of specimens.	Collection.
5297.....	36	Carlisle, Pa.....	S. F. Baird.....	In alcohol..	U. S. National Museum.
5433.....	1	do.....	do.....	Dry skin...	Do.
5375.....	1	Washington.....	(?).....	In alcohol..	Do.
5298.....	1	do.....	C. Girard.....	do.....	Do.
5440.....	1	Hampshire Co., Va.....	M. McDonald.....	Dry skin.....	Do.
5340.....	2	Clark Co., Va.....	Dr. Kennerly.....	In alcohol..	Do.
5339.....	1	Mount Vernon.....	(?).....	do.....	Do.
5341.....	1	Whitfield Co., Ga.....	A. Gerhardt.....	do.....	Do.
5442.....	1	Georgia.....	W. Cooper.....	Dry skin.....	Do.
5343.....	1	New Orleans.....	N. O. Acad.....	In alcohol..	Do.
5401.....	1	St. Louis, Mo.....	Dr. G. Engelmann.....	do.....	Do.
5318.....	1	Cairo, Ill.....	R. Kennicott.....	do.....	Do.
5360.....	1	Poteau Creek, Ark.....	Dr. G. C. Shumard.....	do.....	Do.
5371.....	3	Matamoros, Mex.....	Lt. Conch (Berl. Col.).....	do.....	Do.
5439.....	1	United States.....	Major Leconte.....	do.....	Do.

2. *Vesperugo hesperus* H. Allen. The western bat. (Plates XX, XXI.)

Scotophilus hesperus H. Allen, Monog. N. A. Bats, 1864, 43.

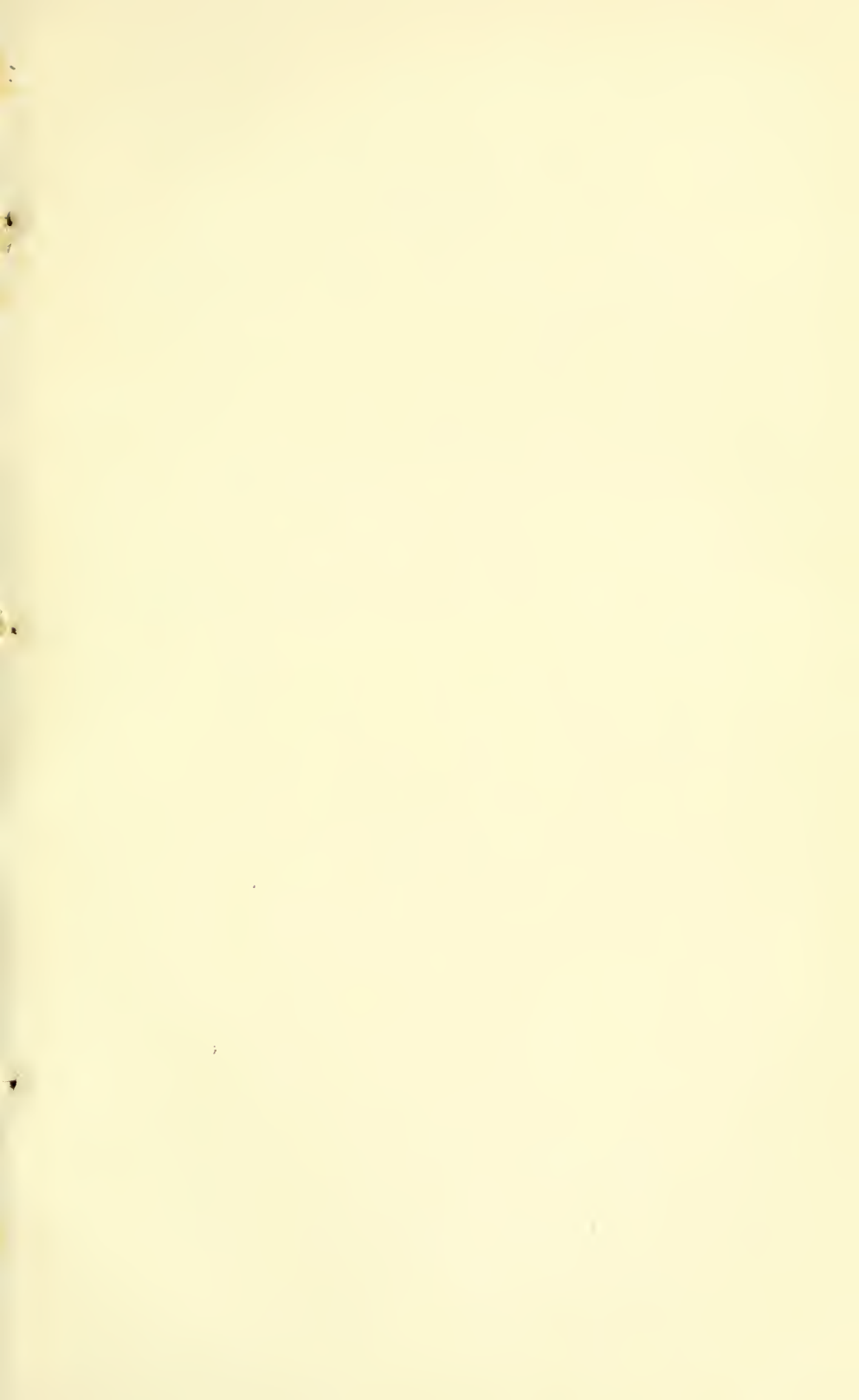
Vesperugo hesperus True, Proc. U. S. Nat. Mus., 1887, 515.

Vesperugo merriami Dobson, Ann. & Mag. Nat. Hist., (v), XVIII, 1886, 124.

Diagnosis.—Smallest bat in the fauna; forearm 26^{mm}. Tragus not half the height of the auricle; inner border concave; outer convex tip blunt. Lower scallop slightly revolute; external basal lobe not revolute oblique; base scarcely wider than the narrow blunt tip; interfemoral membrane ample with post calcareal lobe; tail extended one-half its length beyond the ankle. The metacarpal of the third digit as long as the forearm; the first phalanx of the same shorter than the second. The second digit not longer than the third metacarpal bone. Foot larger than the thumb, equals over one-fifth of the length of the forearm. Penis cylindrical. In the third maxillary molar a trace of the last limb of the second V is discernable. Transverse line on the interfemoral membrane interrupted at the pubotibial line.

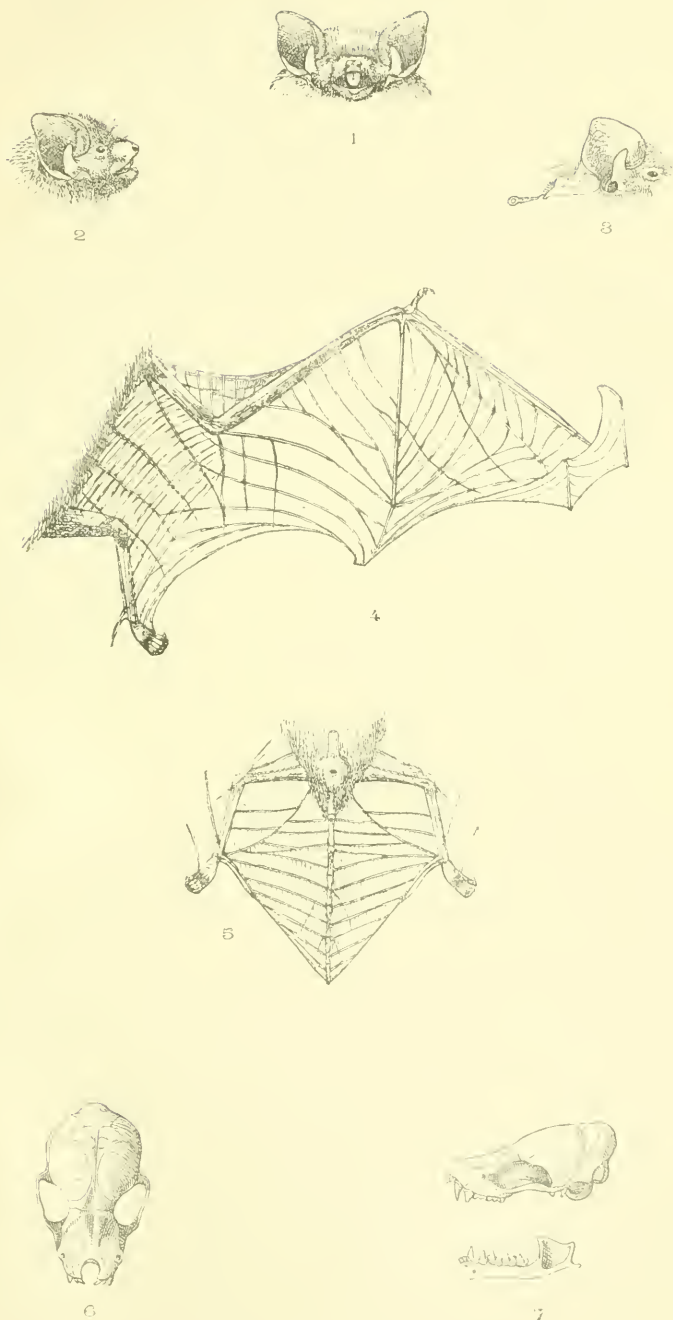
The manual formula is expressed as follows:

	Millimeters.
First interspace.....	1
Second interspace.....	6
Third interspace.....	22
Forearm.....	26

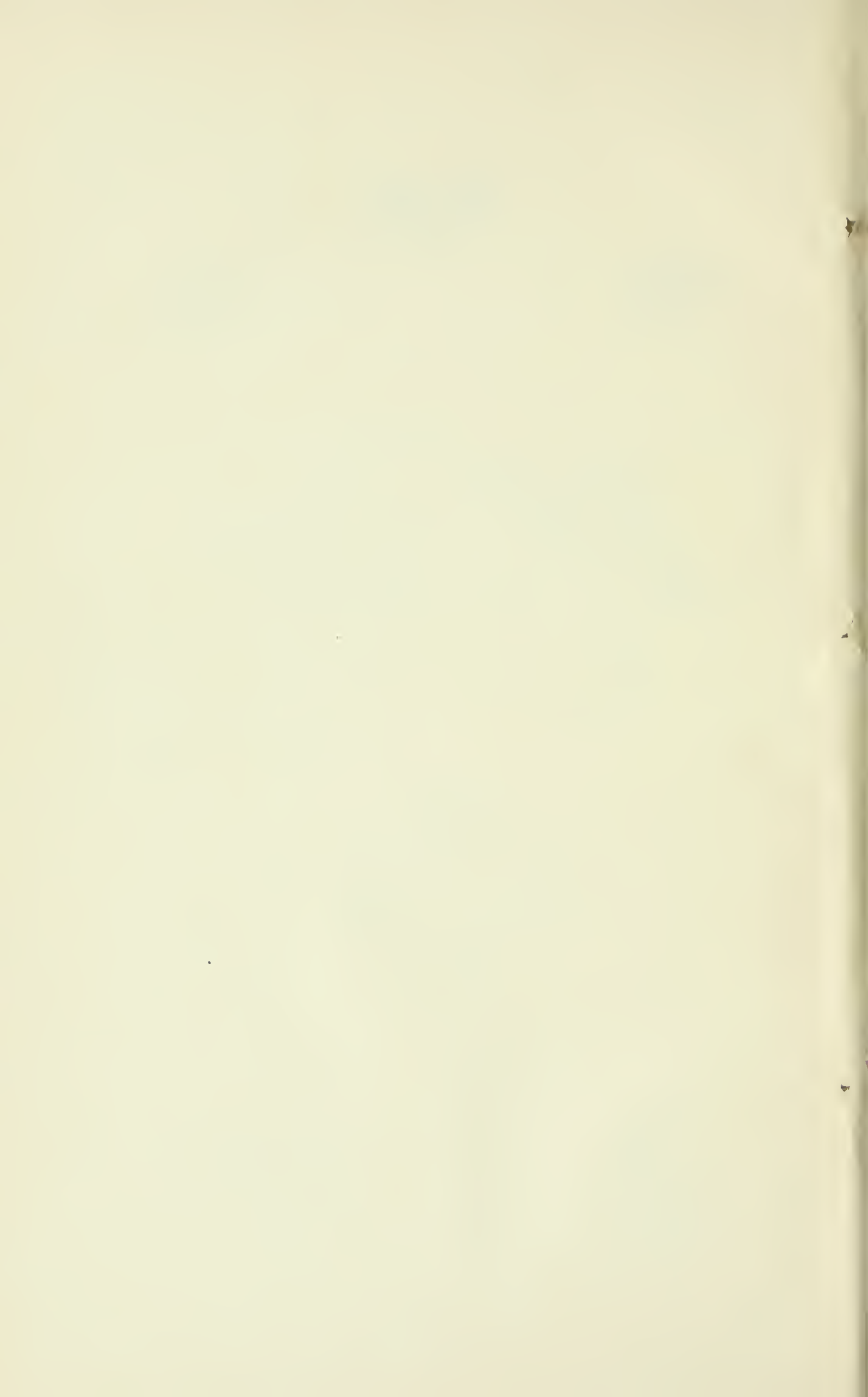


EXPLANATION OF PLATE XX

- FIG. 1. Front view of head of *Vesperugo hesperus*.
FIG. 2. Side view of same.
FIG. 3. View of fragus and inner surface of auricle.
FIG. 4. Wing membrane.
FIG. 5. Tail and interfemoral membrane.
FIG. 6. Skull seen from above. x 2.
FIG. 7. Skull and lower jaw seen from the side. x 2



VESPERUGO HESPERUS



Description.—Ears oval;* the anterior border of the ear sharply convex, inclining backward and upward to the rounded tip; the upper half of the posterior border is concave and without scallop. The lower half is provided with a small, reverted scallop, which is continuous with that of the space between the external ridge and the nonrevolute slightly tapering, external basal lobe; a delicate flang extends from the lobe to the angle of the mouth.

The fur is thicker on dorsum than on venter. It is black at the basal two-thirds and dark gray verging to light ocher or almost white, at the tips. It is lighter on the crown than elsewhere. On the venter the same colors prevail as on the dorsum, but the gray color is of a lighter shade and tends to become white. The fur is unusually compact on neck and below the lower jaw.

In No. 5406, U. S. N. M., the second digit is as long as the third metacarpal, *i. e.*, the phalanx does not extend beyond the third metacarpal phalangeal joint. The penis is slightly flattened and ends in a moderately expanded prepuce.

Membranes.—Intercostals three in number, the lowest appearing at the knee and passing to the free margin of the endopatagium. Coraco brachialis fascicle appears at the middle of the humerus; it is simple and apparently joins a vertical line which is extended downward from the elbow. The triceps fascicle system with a single inferior line, but with no superior obliques. The fourth interspace with digital nerves as in *Vespertilio*, in this regard markedly differing from other examples of *Vesperugo* which have been examined. The interfemoral membrane is provided with a pubocalcaneal line.

Mr. Dobson is inclined to believe that *V. hesperus* is identical with *V. abramus*, an old world species of extensive range being found in middle Europe, the oriental region, and the northern part of the Australian region (see Appendix). But American zoölogists have not agreed with this opinion. Mr. F. W. True has made this question the subject of a special note (Proc. of the U. S. Nat. Mus., 1887, p. 515) and concludes that *V. hesperus* is "distinct and valid." Mr. Dobson describes a specimen of *Vesperugo* from North America under the name of *V. merriami*. This specimen I have not seen. Mr. True believes that it is the same as the *V. hesperus* of the monograph. This is conclusive that Mr. Dobson after examining *V. hesperus* (as identified by Mr. True) did not recognize it to be the same as *V. abramus*, but a distinct species. The material upon which the original description was based was imperfect. It consisted of two dry, imperfect skins and a single alcoholic specimen. It has been obtained since in abundance.

Maxillary teeth.—Incisors both conical and unicuspid. The median the larger. A small space between the lateral and the canine. The first premolar minute as in *Atalapha* and wedged in between canine and second premolar inside the longitudinal axis of the tooth row. The re-

* In the monograph, the statement on page 41 that the ears are rounded is an error.

maining teeth much as in *Vesperugo carolinensis*, excepting in the last molar, where a trace of the last limb of the second V is discernible. The drawing exhibits this rudiment a little longer than is the average.

Mandibular teeth.—The lower incisor with third tooth contiguous with second incisor and with canine. The first premolar in firm contact with the canine. In other respects the teeth are as in *Vesperugo carolinensis*.

Skull.—No trace of posterior temporal crests or sagittal crests are seen. The anterior temporal crest is well defined. The mesencephalon three and one-third times the length of the skull. No nasal eminence is seen; a shallow groove is present at the anterior third of the face vertex; back of this groove lies a well-defined oval pit. The infra-orbital canal is as in *A. fuscus*. Both the groove and the pit are sharply limited at the sides by lateral ridges. The upper surface of the maxilla is depressed.* The paroccipital process is rudimentary and scarcely visible. The tympanic bone is incomplete above.

Notes on the skeleton.—The bones much the same as in *Vesperugo carolinensis*. The free end of coracoid with long process on the vertical side instead of the small tubercle of the species just named. The pectineal spine of the innominate bone aciculate, long, equaling one-fifth the length of the ilium. The thyroid foramen is subround, the ischium narrow, the tuberosity prolonged, the posterior border of the innominate nearly horizontal. Sacrum composed of four elements.

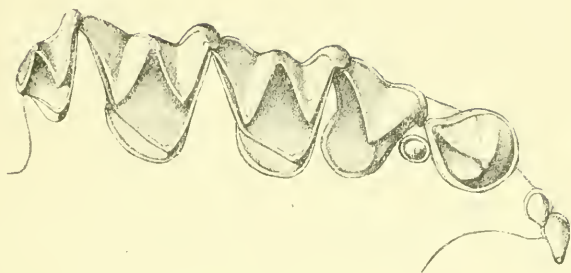
Habitat.—*Vesperugo hesperus* ranges from the low, hot plains of Mexico upward into the Californian basin through the valley of the Colorado River and the surrounding country. Dr. Merriam informs me that it is never found in the mountains and the limit of its distribution is sharply limited to the lower ranges of hillsides and to the plains. According to the same observer (N. A. Fauna, No. 3, 1890, 37) *V. hesperus* is found in swarms in the Grand Cañon of the Colorado River. It inhabits the crevices of the cliffs and is often found drinking from springs. "The flight of this species is so swift and zigzag that it is a very difficult species to shoot in the rapidly failing light. The young, as usual among bats, fly more slowly and steadily and are easily killed." It inhabits crevices in cliffs and begins to fly before dark in the evening, at which time swarms of them come up over the brink of the cañon and flit about among the pines and piñon.

Measurements.

[San Sebastian, Cal. ♂ Cal. Acad. Sci.]

	Millimeters.
Head and body (from crown of head to base of tail)	26
Length of arm	16
Length of forearm	26
First digit:	
Length of first metacarpal bone	1
Length of first phalanx	1½
Second digit:	
Length of second metacarpal bone	26
Length of first phalanx	1

*The hard palate is depressed, saucer-shaped, i. e., is equally concave from before backward and from side to side.

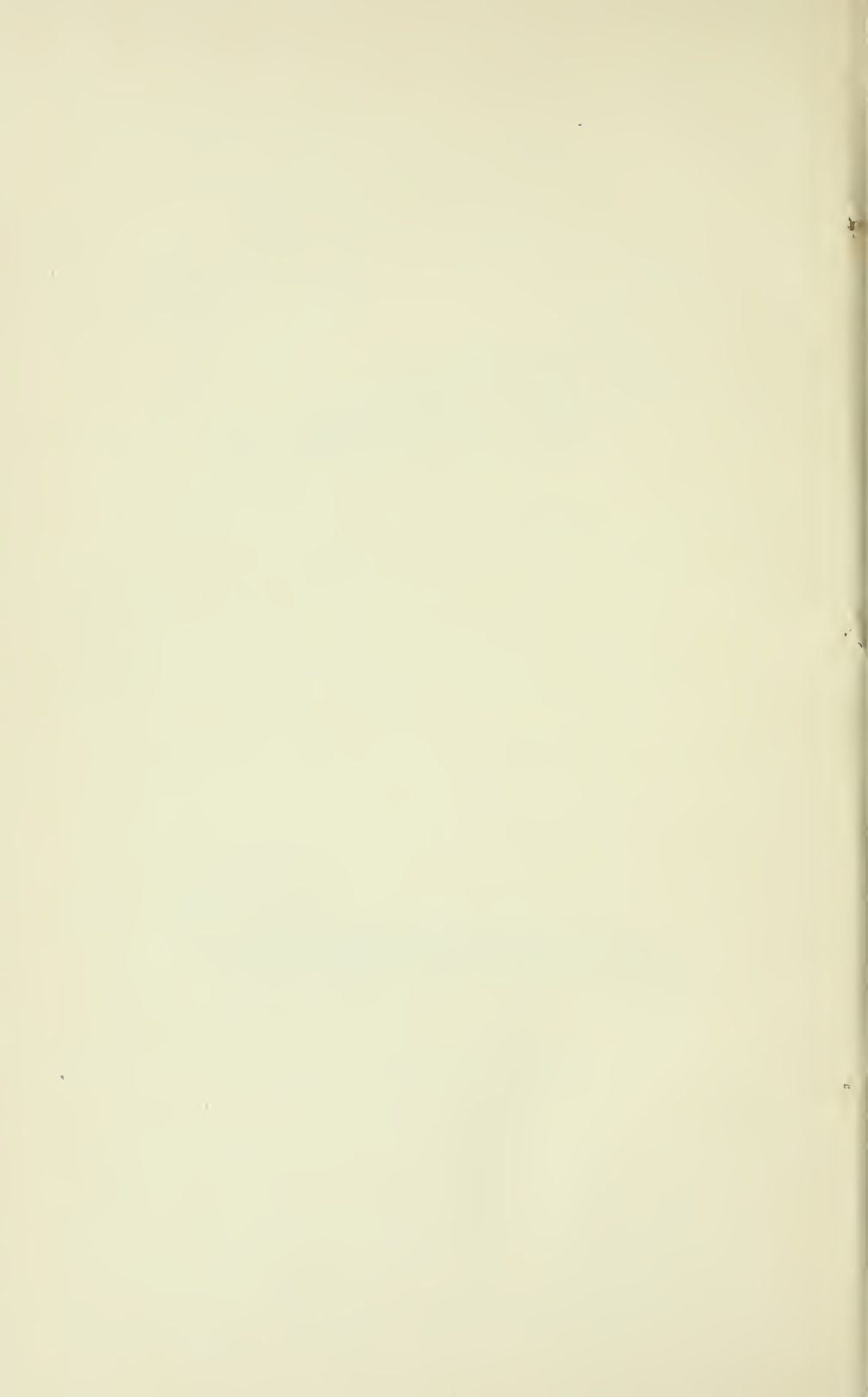


1



2

1. MAXILLARY TEETH OF *VESPERUGO HESPERUS*. X 16.
2. MANDIBULAR TEETH OF SAME. X 16.



Measurements—Continued.

	Millimeters.
Third digit:	
Length of third metacarpal bone.....	26½
Length of first phalanx.....	6
Length of second phalanx.....	9
Fourth digit:	
Length of fourth metacarpal bone.....	25
Length of first phalanx.....	7
Length of second phalanx.....	6
Fifth digit:	
Length of fifth metacarpal bone.....	25
Length of first phalanx.....	5
Length of second phalanx.....	4
Length of head.....	13
Height of ear.....	10
Height of tragus.....	11½
Length of thigh.....	11½
Length of tibia.....	10
Length of foot.....	4½
Length of tail.....	28

Measurements from first edition of Monograph.

Current number.	From tip of nose to tail.	Length of tail.	Length of forearm.	Length of tibia.	Length of longest finger.	Length of thumb.	Height of ear.	Height of tragus.	Expanse.
	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>
5406	1.4	1.0	1.1	0.5	1.8	0.1	0.3	0.1½	7.0
6015	1.4	?	1.1	0.5	1.6	0.1½	0.5½	0.1½	?
5510	1.9	0.11	1.4	0.4	2.0	0.1½	0.4	0.1	7.0

List of specimens.

Cat. No.	No. of specimens.	Locality.	Presented by—	Nature of specimen.	Collection.
5406	1	Fort Yuma, Cal.....	Maj. G. H. Thomas.....	Alcoholic.	U. S. N. M.
5510	1	Posa Creek, Cal.....	Dr. A. L. Heermann.....	Dry.....	Do.
5509	1	do.....	do.....	do.....	Do.

Genus **NYCTICEJUS** Rafinesque.

Nycticejus Rafinesque, Journal de Physique, XXXVIII, 1819, 417.

Atalapha Cones and Yarrow, Wheeler's Exped., Zoöl., 1875-'87.

Diagnosis.—Bats with small tragus having a uniform convex outer border. Large head fold to auricle, scallops not revolute. Chin plate and upper lip at muzzle well defined, the former not triangular. Tip of coracoid process broader than base and deflected toward the vertebral border of the scapula. A single conical upper incisor on each side not touching canine. Face naked. The manal formula is as follows:

Dental formula.—Molars $\frac{3}{3}$, premolars $\frac{1}{2}$, canines $\frac{1}{1}$, incisors $\frac{1}{3} \times 2 = 30$.

Nycticejus has the dental formula of *Dasypterus*. It is distinguished from this genus by the fact of the axis of the paracone of the upper premolar, if produced, intersecting the protocone near its anterior border, and by the upper incisor being separated by an interval from the canine.

	Millimetres.
Second interspace.....	1½
Third interspace.....	8-9½
Fourth interspace.....	26-27½
Forearm.....	18-20

By the number of upper premolars and incisors *Nycticejus* approximates *Scotophilus*, *Rhogeïssa*, and *Atalapha*. Cones and Yarrow, indeed, (Wheeler's Expedition, 1875), place it with the genus last named. Mr. Oldfield Thomas is inclined to place it with *Vesperugo* (see *infra*). In my opinion the structural peculiarities are of a character which warrant a separate generic diagnosis. The nearest ally of *Nycticejus* is *Rhogeïssa*, which may be said to represent it in the South American fauna. In the details of the molars and of the wing membranes it is unlike any of the forms of our fauna, but most resembles *Adelonycteris* and *Vesperugo*. Until Peters identified the *Scotophilus* of Leech, *Nycticejus* was thought to be distributed throughout the tropical belt of the Old World. It is now held to be confined to the warm southern parts of the United States and Central America.

O. Thomas (quoted in Mammals Living and Extinct, Flower and Lyddeker, 1891,) credits *Nycticejus* to *Scotophilus*. I can not agree with this determination. In *Scotophilus* the last upper molar is like *Atalapha*; in *Nycticejus* it is like *Vesperugo*. The details of the lower molars are absolutely different. The hypoconid in *Scotophilus* is small, narrow and blunt; the triangle composed of blunt cusps with shallow interspaces. The hypoconid is large, larger than the triangle (which is compressed from behind forward as in *Nyctinomus*), and has high aciculate cusps. The character of elbow-movement is distinct in the two forms. In *Scotophilus* the inner radial facet on the humerus is weak, scarcely at all concave. The joint is strengthened by a bold, trenchant epitrochlea. In *Nycticejus* the inner radial facet on the humerus is deeply concave and sharply defined, thus strengthening the joint, while the epitrochlea is small and feeble. The palate is prolonged backward markedly in *Scotophilus*, but scarcely at all in *Nycticejus*.

1. *Nycticejus humeralis* O. Thomas. (Plates XXII, XXIII.)

Nycticejus crepuscularis Leconte Cuv. An. Kingd. (McMurtrie's ed.), 1831, 432; Jas. Leconte, Acad. Nat. Sci. Phila., 1855, 433; H. Allen, Monog. N. A. Bats, 1864, 12, figs. 9-11.

Fespertilio crecks F. Cuv., Nouv. Annal. du Mus., Paris, 1, 1832, 18.

Fespertilio aenobarbus Temminck, Monog. Mam., 1835-41, 247, Pl. 58, Fig. 4, *vide* Peters, MB. Akad. Berl., 1866, 681.

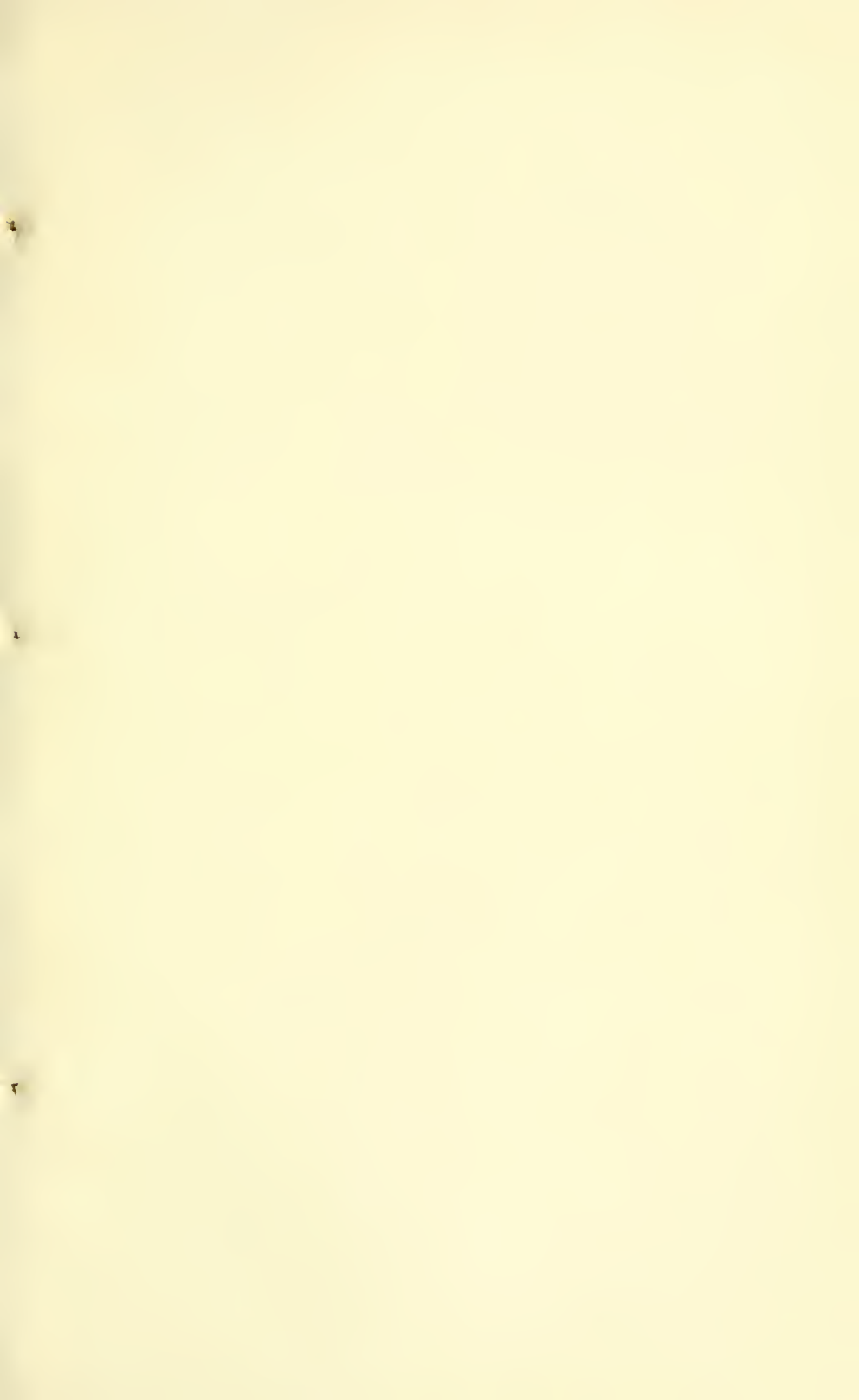
Vesperus cubanus Gundlach, MB. Akad. Berl., 1866, 681.

Nycticejus humeralis O. Thomas. Ann. & Mag. N. H. VII, 1891, 528.

In the monograph of 1864 I queried whether or not *N. humeralis*, Rafinesque, was the same as *N. crepuscularis*. I have since concluded that they are the same and, therefore, agree with Mr. Oldfield Thomas in accepting this name.

Diagnosis.—The diagnosis of the single species, that of the genus.

Description.—Auricle small, shorter than the head, the portion above the head oval; outer border scarcely concave, tip obtuse. Internal basal lobe bold, thick, inferiorly forming a minute pendant point; anterior border abruptly convex; it does not touch the head, but is raised



EXPLANATION OF PLATE XXII.

- FIG. 1. Front view of head of *Nycticejus humeralis*.
FIG. 2. Same, showing cleft mental plate.
FIG. 3. Side view of *Nycticejus humeralis*.
FIG. 4. View of tragus and inner surface of auricle.
FIG. 5. Wing membrane.
FIG. 6. Tail and interfemoral membrane.
FIG. 7. Skull seen from above. x 2.
FIG. 8. Skull and lower jaw seen from the side. x 2.



1



2



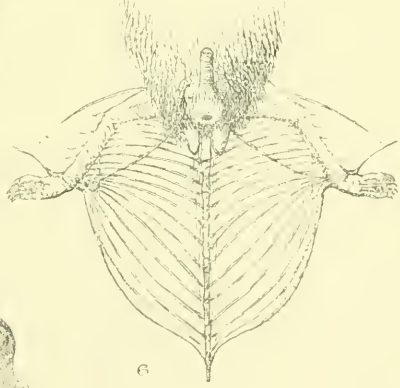
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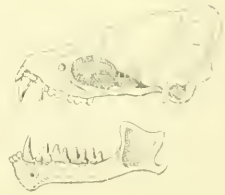
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6



7



8



therefrom by the head-fold. The keel (internal basal ridge) prominent, well defined. External basal lobe well developed, nearly naked, with base placed well below the line of the mouth and its anterior border nearly at right angles therewith. The external basal ridge continues with the external border of the auricle and constitutes the margin of the first scallop, which is thus obscurely defined. The second scallop is well-outlined, convex, and ends on the outer surface of the external basal lobe. The tragus is nearly one-half the height of the auricle; the broadest part extends from the inconspicuous notch to the apical third, where it abruptly narrows to a blunt tip; the anterior border is straight or slightly concave, the posterior convex ("dolabri-form" Leconte). The mentum is well defined and, as a rule, undivided. The pollical callosity is round, conspicuous, 2^{mm} wide. No post calcaral lobe or lobe at tip of the calcar (apical calcaral lobe) is present. A wart is placed well below the angle of the mouth.

Dorsum throughout of a light ash-grey color, the basal, one-third to two-thirds, being dark-brown. Venter the same, with the brown hues of the shafts being more conspicuous. The sides of the neck less ash than elsewhere, hence the effect of this region is that of nearly brown throughout. The degree of ashy hue of the dorsum is variable in specimens from one locality and may be absent when the hair is uniformly brown, the shaft simply being darker in shade than the tip. The venter is quite constant in color in all individuals examined.

The material available for study is not sufficient for me to decide which of the two styles of coloration of the dorsum is the most frequent. It may be that the grey variety is a sign of advanced maturity, all the examples were those of lactating females, although some of the brown variety were also in the same condition.

On the dorsum the hair extended to the middle of the humerus and downward thence to the knee. The interfemoral was turned only at the basal fourth. In the venter the hair extends on the humerus only as far as the end of the pectoral ridge and on the thigh to the proximal and thence along the side of the body to the middle of the thigh. The lower fourth of the interfemoral was alone furred.

Variations.—In No. 6060 Arkansas (M. C. Z.) the post-calcareal lobe is present. The tragus is less than one-half the height of the auricle. The last caudal vertebra is free.

In No. 8172 U. S. N. M. (Carlisle, Pa.) is similar to the Southern form, except that the external basal lobe is as high as it is long, and the summit is surrounded, and the inner border of the tragus straight. A large pendant skin-fold extends the entire length of the right side of space below the lower jaw. This asymmetrical fold is of interest since no similar disposition exists so far as I know in any other bat.

In No. 4735 U. S. N. M. the fur on the dorsum is everywhere dark, lustrous brown at the apical third, and black at the basal; two-thirds on the rump it is brown throughout. On the venter the apical tints are lighter.

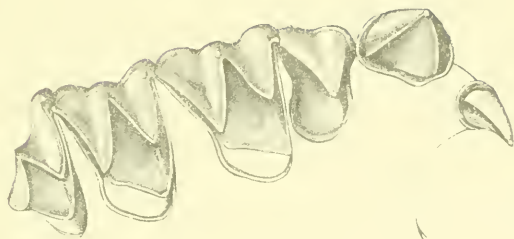
Membranes.—Intercostals four in number. The coraco-brachialis fascicle appears near the axilla and becomes vertical a little beyond the elbow. The triceps fascicle system with a single superior oblique and a single vertical inferior branch. The line above the main trend of the nerve as in *A. fuscus*. The fourth interspace as in this species except that the postdigital appears at the proximal sixth of the fourth metacarpal bone. In one specimen it was absent. The oblique tibial and pubo tibial lines as in this species. In No. 4378 the lines in the fourth interdigital space arise from the digits, the postdigital from the proximal third and the predigital from near the middle.

Skull.—The sagittal crest is defined its entire length. The posterior temporal ridge is trenchant, limiting a small triangle. The anterior temporal ridge is also well defined and ends on the orbital ridge which is sharply outlined, and is continuous with an oblique line which crosses the flat inner wall of the orbit. The fronto-maxillary inflation is rudimental,—the least developed in any of the species. The face-vertex is without depression in some examples; in others it is shallow, and less than half the length of the region. (Such specimens may not be entirely mature.) Two shallow depressions overlie the maxillæ. The facial infraorbital foramen lies over the interval between the second premolar and the first molar. The anterior nasal aperture ends on the line of the anterior border of the second premolar. The paroccipital process is acuminate and projects downward no farther than the level of the inflated mastoid. The interval between these two processes is concave and incised below. The tympanic bone is incomplete above the head of the malleus intervening. The coronoid process lies above the level of the condyle and slightly exceeds the width of the adjacent horizontal ramus. The massetric impression reaches the lower margin of the ramus. The angle is small, truncate, and slightly produced beyond the line of the condyle.

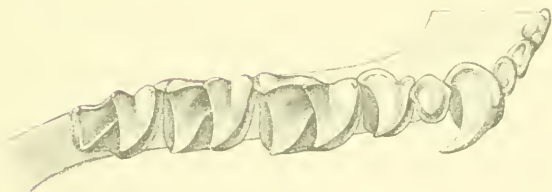
The encranial surface is about one-third the area of the entire region, the cribriform plate marked as follows: First, a single opening is seen on the sphenoturbinal surface; second, two openings on the ectoturbinal surface; third, a relatively large depression on the endoturbinal, containing two openings, well to the lateral aspect, for the first endoturbinal plate.

The nasal surface exhibits a single ectoturbinal plate. It is a little less than one-half the length of the first endoturbinal, is directed almost vertically downward, the swollen upper border looking outward. The lateral surface is concave, deflected outward as far as the tip of the first endoturbinal. It is slightly concave above. The free portion is acuminate, reaching as far as the level of the canine tooth. The second plate is as in *V. fuscus*, but not so much narrowed at the base. The third is a mere rounded nodule.

Maxillary teeth.—The incisor slender, simple, with entire cingulum vertical on border of palatal notch; a small space between it and the canine. The palatal surface of the canine concave, broad; posterior



1



2

1. MAXILLARY TEETH OF NYCTICEJUS HUMERALIS. X 12.
2. MANDIBULAR TEETH OF SAME. X 12.



narrow concave in line with longitudinal axis of tooth row; borders abruptly raised, thin. Single premolar not distinctive. The Vs of the first and second molar subequal; the protocone with obscurely defined posterior commissure which ends at the apex of the second V. The heel is rudimental, its apex appearing on the top of the protocone. The third molar with protocone as in the other molars, but the posterior limb of the second V absent.

Mandibular teeth.—The incisors crowded. First with trifid cutting edge, more inclined forward than the second and third, which are blunt, thick, and bearing a mere nodule on the cutting surface. Canine with broad concave posterior and narrow concave lingual surface, the two separated by a sharp longitudinal flange. The heel like base, low and broad. The first premolar wedged in tooth row by the basal lines of the adjacent teeth; much smaller than the second, with the lingual cingulum angulated. The second premolar with anterior basal cusp on lingual part of the cingulum advanced. The first and second molars not distinctive. The third molar with a small deflected heel, which, while triangular, is much compressed from without inward.

Notes on the skeleton.—Atlas with minute spine from the transverse lamina; the lower of the two foramen not seen from in front. Axis without lateral oblique spine.

Scapula with thin axillary border; triceps impression without rugosity or spine; the superior angle scarcely inflected; tip of the coracoid process is broader than the base and is deflected toward the vertebral border. Humerus with internal tuberosity not higher than head and of about the same size as the external tuberosity. Ulna in some specimens ankylosed to radius at proximal end. Apparently attached to this bone about at distal third of the shaft, but in fact ending free as in *Adelonycteris*, *Vesperugo*, and *Vespertilio*. The distal end with square perforated lamina. Innominate bone with narrow subrounded ilium not expanded above. Proximal end of tibia with large spine. The first metacarpal bone equals the phalangeal series in length.

Sexual characters.—The proportion of the sexes could not be determined by the material available. Many of the specimens examined (all of those from Carlisle, Pa., N. M.) were lactating females, while of the nine specimens in the Museum of Comparative Zoology seven were males. The penis (see specimen No. 1185, Cam. from Seabrook Island, South Carolina) is long (8^{mm}), pendulous, cylindrical, and without expanded prepuce. In this respect the parts are quite dissimilar to *A. fuscus* and closely resemble *Atalapha*. Testis on side of base of tail.

The brain.—The flocculus of the cerebellum not projected. The anterior portion of cerebrum (rhinocele) abruptly constricted from the pyriform figure of the hemisphere.

Habitat.—This species has not been recorded in the United States in regions beyond the South Atlantic slope and the country extending west to the Mississippi and north to the Middle States as far as Pennsylvania. One specimen was formerly in the Smithsonian Institution,

collected from Nebraska; several from Arkansas, and one from Matamoras, Tex. Dobson's statement that it is found in the Rocky Mountains is not accompanied by reference to collections. There is one specimen in the British Museum from Central America.

Measurements.

	U. S. N. M. 4735 ♀ skin.	U. S. N. M. 5329 ♀ alcohol.	M. C. Z. 4378 ♂ alcohol.	M. C. Z. 1185 ♂ —.
	<i>Mm.</i>	<i>Mm.</i>	<i>Mm.</i>	<i>Mm.</i>
Head and body (from crown of head to base of tail)...	37	37	36	39
Length of arm	18	18	19	20
Length of forearm	32	35	30	34
First digit:				
Length of first metacarpal bone	2	2	2	2
Length of phalanges	3	5	3	3½
Second digit:				
Length of second metacarpal bone	30	32	28	29
Length of first phalanx	2	3	2	2
Third digit:				
Length of third metacarpal bone	32	33	30	32
Length of first phalanx	12	12	11	12½
Length of second phalanx	10	9	9	—
Fourth digit:				
Length of fourth metacarpal bone	31	33	30	31
Length of first phalanx	11	12	10½	11
Length of second phalanx	8	7	6½	—
Fifth digit:				
Length of fifth metacarpal bone	29	33	29	30
Length of first phalanx	6½	8	6½	8
Length of second phalanx	—	4	4	4
Length of head	15	—	15	16
Height of ear	8	—	8	7½
Height of tragus	3	—	3	3½
Length of thigh	10	10½	11	10
Length of tibia	11	11	14	12
Length of foot	6	—	6	7
Length of tail	30	30	30	31

Measurements from first edition of Monograph.

Current number.	From tip of nose to tail.	Length of tail.	Length of forearm.	Length of tibia.	Length of longest finger.	Length of thumb.	Height of ear.	Height of tragus.	Expanse.	Nature of specimen.
	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	
5312	2.0	1.5	1.4	0.6	2.6	0.4	0.4	0.2½	9.6	Alcoholic.
2.0	1.5	1.4	0.6	2.6	0.4	0.5	0.2	0.2½	9.9	Do.
2.0	1.5	1.4	0.6	2.5	0.3	0.4	0.3	0.3	9.3	Do.
5313	2.0	1.4½	1.4	0.6	2.6	0.3	0.4	0.3	9.3	Do.
5322	1.5	1.4	0.6	2.6½	0.4	0.5	0.3	—	—	Do.
5329	2.0	1.2	1.3	0.6	2.3½	0.4	0.4	0.2½	9.3	Do.
2.0	1.2	1.6	0.6	2.7	0.4	0.4½	0.2½	—	—	Do.
4735	2.0	1.2	1.3	0.6	2.5	0.4	0.4	0.2	3.6	Dry.
4736	2.0	1.2	1.3	0.6	2.1	0.3	0.3½	0.2	7.9	Do.
111	1.6	—	—	—	2.2	0.3	0.4	0.2	—	Do.
283	1.9	1.4	1.4	0.6	2.2	0.3	0.4	0.2½	7.6	Do.
882	2.0	1.3	1.5	0.6	2.4	0.3	0.6½	0.3	8.0	Do.

List of specimens.

Cat. No.	No. of specimens.	Locality.	Presented by	Nature of specimen.	Collection.
5448	1	Carlisle, Pa.	S. F. Baird	Dry	U. S. N. M.
5350	1	Washington, D. C.	(?)	Alcoholic.	Do.
5312	2	Liberty Co., Ga.	Dr. Jos. Jones	do	Do.
5313	1	New Orleans	N. O. Academy	do	Do.
5300	1	St. Louis, Mo.	Dr. G. Engelmann	do	Do.
5322	1	Nebraska	Dr. Cooper	do	Do.
5397	1	Redmond's Ranch, Tex.	J. H. Clark	do	Do.
5372	3	Matamoras, (Berl. Col.)	Lt. D. N. Couch	do	Do.
5329	2	do	do	do	Do.
4736	1	"United States."	Maj. Leconte	Dry	Do.
5539	1	(?)	(?)	do	Do.

Genus **DASYPTERUS**, Peters.

Dasypterus, Peters, MB. Akad. Berlin, 1870, 904.

Atalapha, Peters, MB. Akad. Berlin, 1870, 912; Dobson, Cat. Chirop. Brit. Mus., 1878, 274.

Lasiurus, H. Allen, Proc. Acad. Nat. Sci. Phila., 1862, 146; Monog. N. A. Bats, 1864, 25.
Nycticejus, Cones and Yarrow, Wheeler's Exped., Zool., 1875, 87.

When I described this form I placed it with *Lasiurus*, but Prof. Peters proposed for it a distinctive generic name, *Dasypterus*, since it possesses one premolar only in the upper jaw. In the propriety of making this change I concur.

Dental formula.—Molars $\frac{3}{3}$ — premolars $\frac{1}{2}$ — canines $\frac{1}{1}$ — incisors $\frac{1}{3} \times 2 = 30$.

Diagnosis.—Ears elliptical; tragus incurved, blunt, with a transverse ridge on the outer surface. The internal basal lobe projects backward beyond the internal ridge. Back of ample interfemoral membrane scarcely hairy. The phalanges of the third digit equal in length. The first phalanx of the fourth and fifth finger longer than the second. The olecranon is free behind—the membrane concealing the region of the elbow in front.

The axis of the paracone of the upper premolar, if produced, intersecting protocone near at its middle. The upper incisor in contact with the canine. (See *Nycticejus*.) The resemblance of the teeth of this genus to those of *Antrozous* have been already noted.

The manual formula is as follows:

	Millimeters.
Second interspace.....	2
Third interspace.....	14
Fourth interspace.....	40
Forearm.....	40

1. *Dasypterus intermedius* (Peters). (Plates XXIV, XXV.)

Lasiurus intermedius H. Allen, Proc. Acad. Nat. Sci. Phila., 1862, 146; Monog. N. A. Bats, 1864, 25.

Dasypterus intermedius Peters, MB. Akad. Berlin, 1870, 904.

Atalapha intermedia Peters, MB. Akad. Berlin, 1870, 912; Dobson, Cat. Chirop. Brit. Mus., 1878, 274.

Nycticejus intermedius Cones and Yarrow, Wheeler's Expedition, Zool., 1875.

Description.—Ears longer than broad, slightly emarginate posteriorly beneath the tip and without black border. The internal basal lobe as in *Atalapha*, but projects but little back of the inconspicuous keel. The external basal lobe rounded without basal notch anteriorly. Hem narrow; it is confined to the notch as in *Atalapha*. The tragus as in this genus; the transverse ridge on the tragus complete. Muzzle and chinplate as in *A. cinerea*. Wing membranes with markings quite as in *Atalapha*. A conspicuous muscle-mass lies between the long calcar and the foot. This incloses a muscle as in *A. noveboracensis*.

The tip of the tail is free. In specimen 6098, Museum of Comparative Zoölogy, the mammary glands were large. The two nipples were near each other toward the axilla, without a furred surface intervening.

Hair everywhere long and silky. Dorsum, including the head, neck, and ears, with hair at the basal half dark brown; apical half old gold. On the membrane from the proximal third of the arm to the knee the hair is the same as on the body. It is longer than the hair in similar positions in the red bat or the hoary bat. A light-brown tuft overlies the first metacarpal bone, and the prebrachium above the elbow. Unicolored light-brown hair sparsely covers the interfemoral membrane as far as a line that unites the ankles. The fleshy extension to the outer side of the calcaneum as in *Atalapha*. Ventre including the submental region and the neck, with basal two-thirds dark brown, apical third light brown; no shades of old gold are present. A sparse growth of light-brown, unicolored hair extends along the forearm its entire length and upon the metacarpus as far as the third digit. The endopatagium from the elbows to the knee is covered with hair having the same characters as the above.

No differentiations are seen on the side of the neck or of body. The ears are covered at the basal two-thirds.*

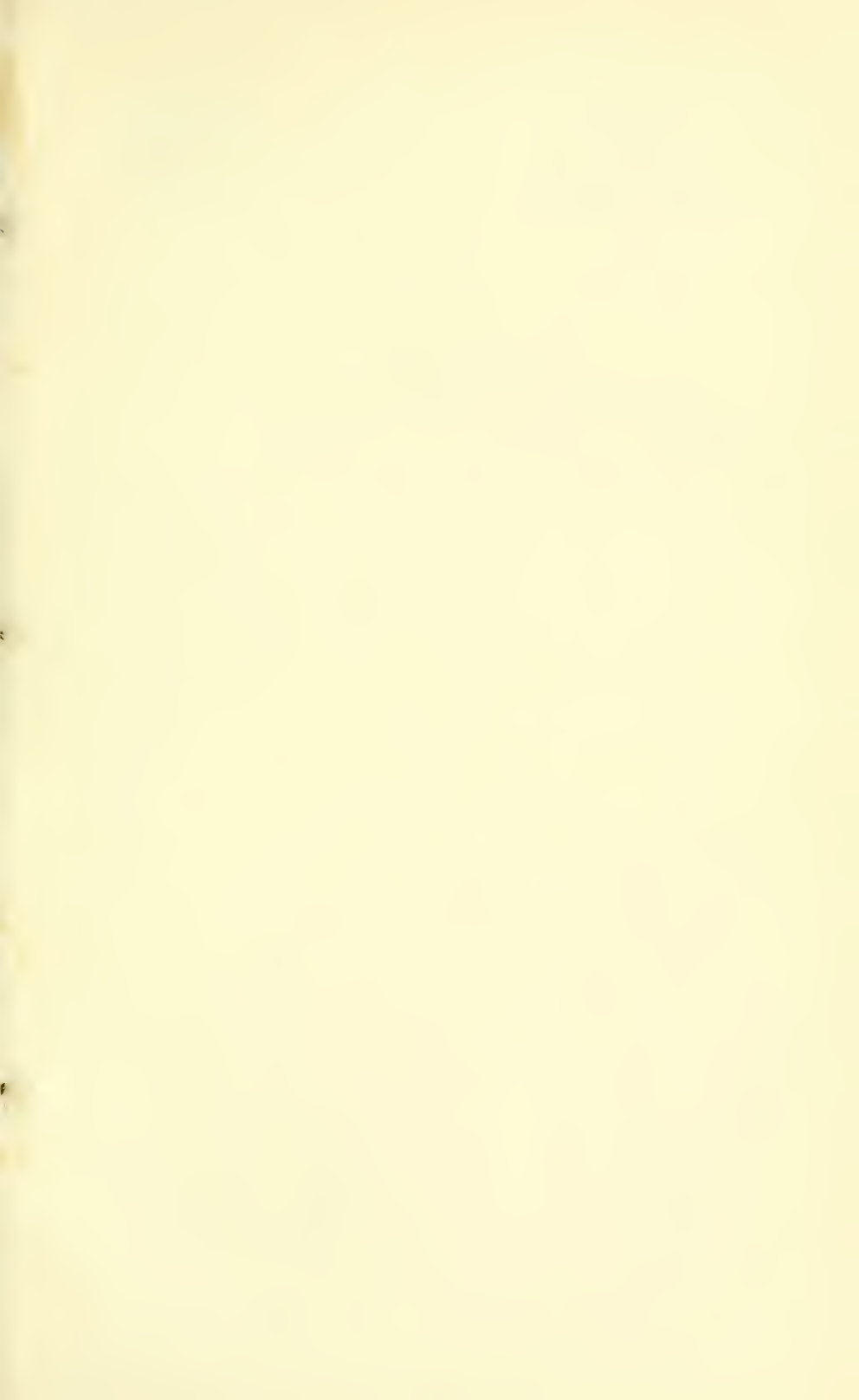
Membranes.—The markings on the wing membranes are so similar to those of *A. cinerea* that they need not be described. The propatagium is not withdrawn behind the ulna at any point.

Variations.—An example from Davenport, Fla., in the collection of Mr. G. S. Miller, jr., Cambridge, Mass., is described as follows:

Dorsum of an obscure ocher brown, flecked with dispersed transverse sooty lines. The color becomes more rusty over the loins and upon the basal half of the interfemoral membrane where it is of a dull russet. The basal fifth is black, the remaining portion is almost white. The subtip is ocher-brown and the tip occasionally black. On the interfemoral membrane the hair is of a dull Isabella brown; the basal black equals one-fifth of the shaft, which is scarcely lighter than the long tip. Thus the shaft is not lighter than on the dorsum. The fold extending from the auricle to the head is heavily furred. Of the two examples one, although the larger, was immature, showing that variation in the measurements of a number of individuals may be expected.

Teeth.—The maxillary incisors much as in *A. cinerea* and *A. noveboracensis*; the cingulum markedly developed; the first premolar is absent. The posterior commissure of the paracone does not reach the posterior border of the tooth, but adjoins against the anterior limb of the second V near its tip; the third molar as in other species.

**Dasypterus ega*, Peters.—A specimen of this species from the collection of the Museum of Comparative Zoölogy. The palatal rugæ are six in number. The lower incisors not trifid, subequal, the first the largest. The fur of the ventre is without tip of different shade to that of the shaft. The hair is of two colors, while on the dorsum it is of three.



EXPLANATION OF PLATE XXIV.

FIG. 1. Front view of head of *Dasypterus intermedius*.

FIG. 2. Side view of same.

FIG. 3. Wing membrane.

FIG. 4. Tail and interfemoral membrane.

FIG. 5. Skull seen from above. $\times 2$.

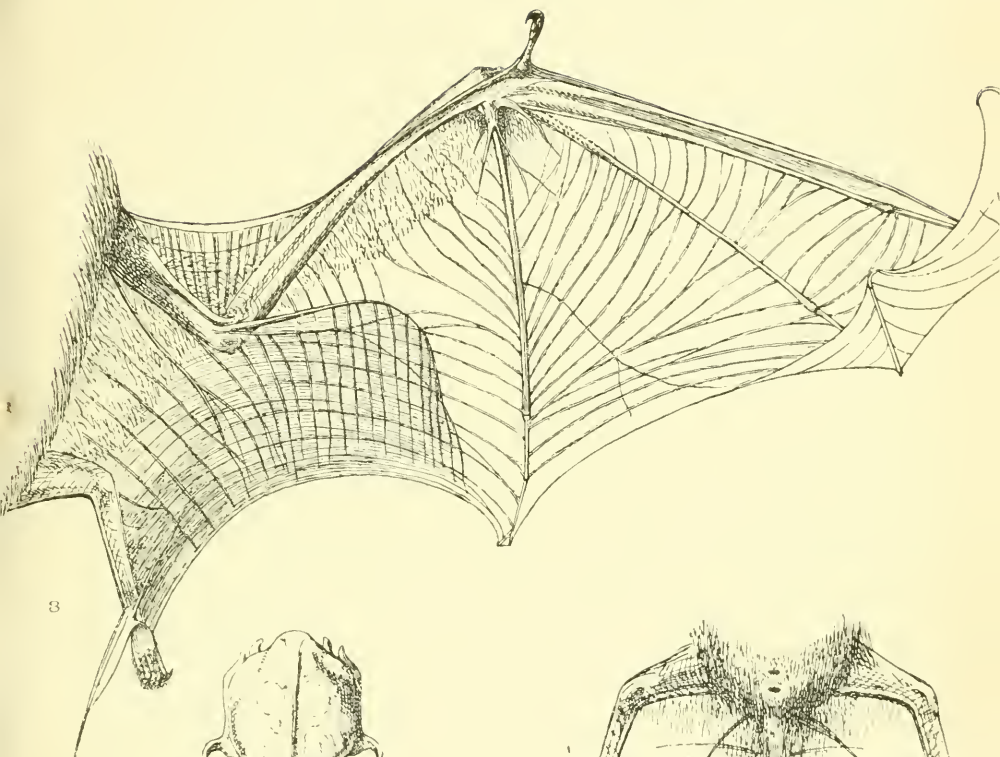
FIG. 6. Skull and lower jaw seen from the side. $\times 2$.



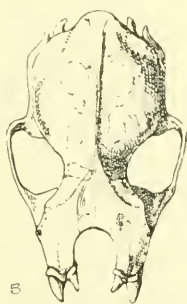
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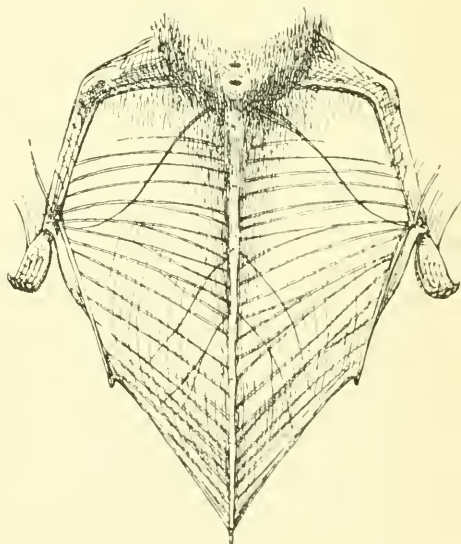
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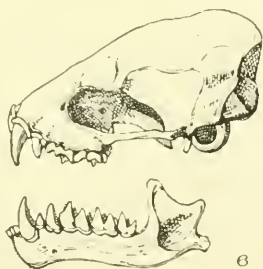
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4



6



The mandibular incisors crowded; the first incisor much larger than the coequal second and third teeth; cutting edge trifid and palatal base produced; the second and third rounded, conoid, and blunt; they are made obscurely bifid in front; the first premolar not more than half the size of the second; the molars quite as in other species.

Skull.—The greatest length is 17^{mm}. The length of mesencephalon is 5^{mm}. The greatest width is 10^{mm}; the least width 5^{mm}. A delicate sagittal crest extends the entire length of the metencephalon and half way over the mesencephalon. The posterior temporal crests are almost parallel with each other over the posterior half of the mesencephalon near the dorsal median line, leaving a conspicuous space which is the homologue of the triangular interval in other genera. The anterior temporal crest is well defined and ends on the orbital crest. The paroccipital process is large, conical directed, backward, and its line intersects the condyle above its center. The mastoid process is slightly produced, but less so than is the paroccipital. The intermediate space is scarcely convex and deeply incised. The tympanic bone is complete. No tubercle lies above the proencephalic foramina. The orbital crest is small and is placed well forward and involves the lachrymal bone. The infraorbital canal is placed high above the teeth; is exceedingly short, permitting a mere rim of bone to lie between the orbital and the facial foramen. The lachrymal foramen is inconspicuous, almost concealed in profile. The line produced from the upper border of the anterior nasal aperture intersecting the first molar. The fronto-maxillary inflation moderately developed and is best defined at the lachrymal region. The lingual process reaches the tympanic bone. The tympanic ring is complete. The zygoma is without elevation on the upper border.

The coronoid process is not as high as is the horizontal ramus. The masseteric impression is weak inferiorly and not quite reaching the lower border of the horizontal ramus. It scarcely impresses the coronoid. The angle forms a flat quadrate process, deeply concave on median aspect and extends scarcely beyond the condyle. As seen from above, it lies in line with the middle of the condyle. The posterior symphysal spine is conspicuous.

Notes on the skeleton.—The triceps impression of the scapula bends more to dorsum than to venter. The glenoid is absolutely straight on median surface excavated above on lateral but very convex inferiorly on same side. The infra-spinous portion of venter with a stout ridge ranging downward and backward from the compact tissue at glenoid. This ridge answers to the concavity on dorsum. In both human and bat scapula the stoutest ridge on venter answers to the deepest concavity on dorsum. In the human variety this lies near the axillary border; in the bat at middle of the dorsum.

Habitat.—Mexico and the Gulf States. It is a rare species and

nothing is known of its life history. The type specimen was obtained at Matamoras, Mexico.

Measurements.

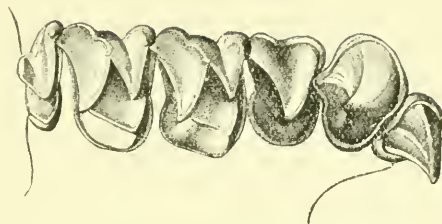
	U. S. N. M. 5382. Immature.	M. C. Z. ♀
	<i>Mm.</i>	<i>Mm.</i>
Head and body (from crown of head to base of tail).....		61
Length of arm.....		28½
Length of forearm.....	54	49
First digit:		
Length of first metacarpal bone.....	4	4
Length of phalanges.....	5½	5
Second digit:		
Length of second metacarpal bone.....	57	54
Length of first phalanx.....	2½	7
Third digit:		
Length of metacarpal bone.....	58	55
Length of first phalanx.....	20	20
Length of second phalanx.....	20	20
Fourth digit:		
Length of fourth metacarpal bone.....	55	49
Length of first phalanx.....	15	13
Length of second phalanx.....	13	11½
Fifth digit:		
Length of fifth metacarpal bone.....	46	44
Length of first phalanx.....	9	7½
Length of second phalanx.....	8	7½
Length of head.....	21	21
Height of ear from head.....	7	8
Height of tragus.....	7	7
Length of thigh.....	18	18
Length of tibia.....	23	21
Length of foot.....	7	8
Length of tail.....	58	50
Length of calcar.....	18	16

Measurements, from first edition of Monograph.

Current number.	From tip of nose to tail.	Length of tail.	Length of forearm.	Length of tibia.	Length of longest finger.	Length of thumb.	Height of ear.	Height of tragus.	Ex- pau- se.	Nature of specimen.
	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	
5328.....	3.0	2.6	2.2	0.11	4.0	0.5	0.7½	0.3	13.0	Alcoholic.
6135.....	2.3	2.2	2.1	0.11	4.0	0.4½	0.7	0.2½	13.6	Do.
6138.....	2.9	2.7	2.1	0.11	4.1	0.4½	0.6½	0.3	15.9	Do.
6137.....	2.6	2.2	2.1	0.11	4.1	0.5	0.6½	0.3	13.3	Do.
6139.....	2.6	2.0	1.9	0.8	3.6	0.5	0.7	0.3	12.0	Do.
6140.....	2.5	2.0	2.0	0.11	4.0	0.3	0.7½	0.3	12.6	Do.
	2.5	2.0	2.0	0.9	2.6	0.5	0.6	0.3	13.0	Do.

List of specimens.

Cat. No.	Number of specimens.	Locality.	Presented by—	Nature of specimen.	Collection.
3228	1	Matamoras, Mex.....	Lt. Couch, U. S. Army (Berl. Coll.).	Alcoholic.	U. S. N. M.
6135	1	do.....	do.....	do.....	Do.
6136	1	do.....	do.....	do.....	Do.
6137	1	do.....	do.....	do.....	Do.
6138	1	do.....	do.....	do.....	Do.
6139	1	do.....	do.....	do.....	Do.
6140	1	do.....	do.....	do.....	Do.

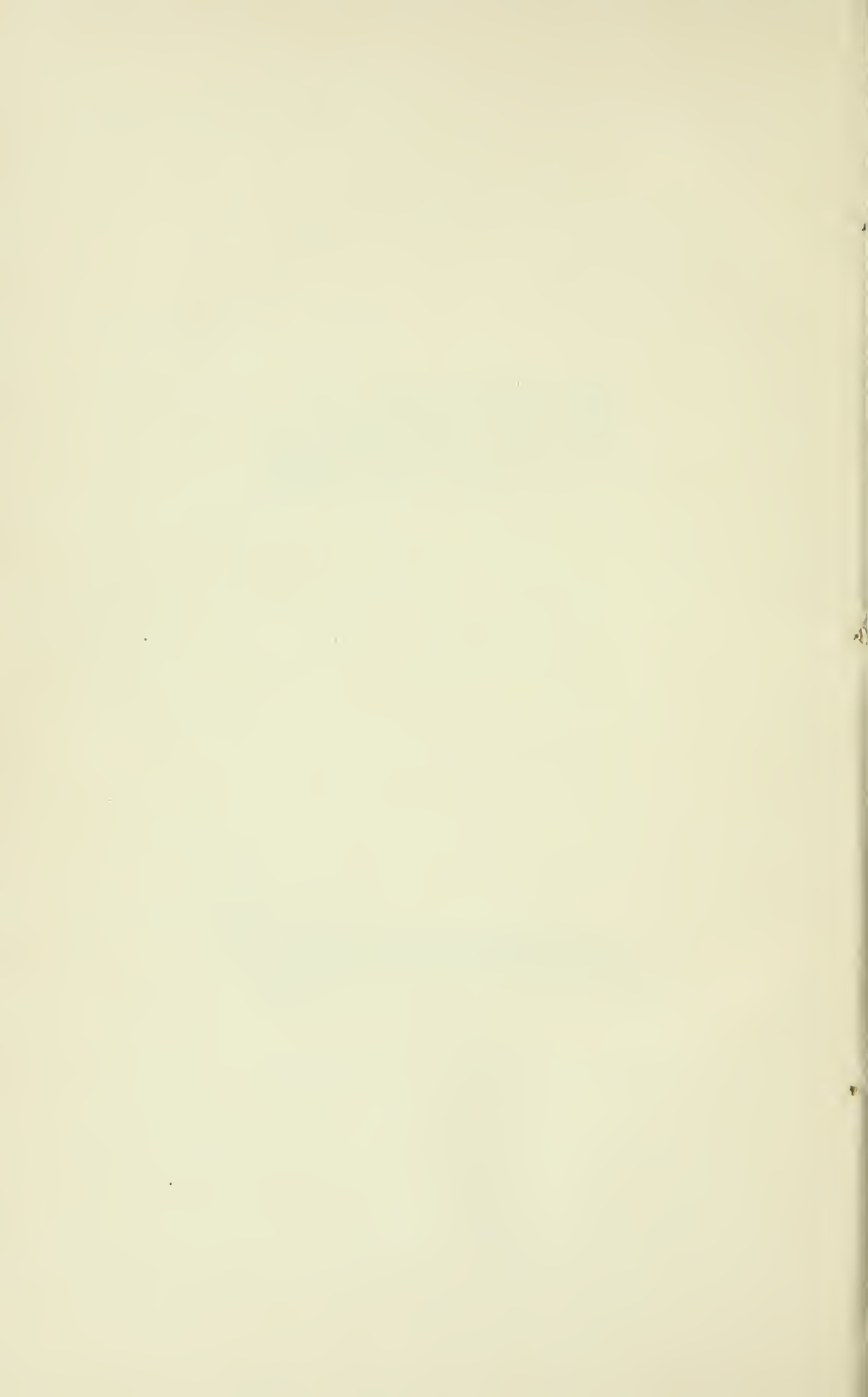


1



2

1. MAXILLARY TEETH OF *DASYPTERUS INTERMEDIUS*. X 12.
2. MANDIBULAR TEETH OF SAME. X 12.



Genus **ATALAPHA** Rafinesque.

Atalapha Rafinesque, Précis des découvertes et travaux somnologiques, 1814, 12; Desmarest, Mam., 1820, 146; Gervais, Hist. Nat. Mam., I, 1854, 211; Peters, MB. Akad. Berlin, 1870, 907; Dobson, Cat. Chirop. Brit. Mus., 1878—Cones & Yar-row, Wheeler's Exped., Zool. 1875, 86.

Scotophilus Gray, Mag. Zool. and Bot., II, 1838, 498.

Lasiurus Gray, List Mam. Brit. Mus., 1843; Tones, Proc. Zool. Soc. London, 1857, 34; Allen, Monog. N. A. Bats, 1864, 14.

In changing *Lasiurus* to *Atalapha* I have followed the tendency of all recent writers. I have never seen the original description of Rafinesque, and recalling the cloud under which most of the work of this eccentric naturalist rested, I thought it better to employ the name of *Lasiurus* of Gray which, although without characterization, was known to apply to a species already identified.

By reference to the diagnosis of *Atalapha fuscata* in the appendix it will be seen that it is impossible to name by its use any species of bat in North America, I assume that Rafinesque's original characterization of *Atalapha* has satisfied such observers as Gervais, Peters, and Dobson of its validity.

The skull without marked depression between the mesencephalon and the metencephalon. The labyrinth concealed at the occiput. A basisphenoid fossa is present. The glenoid tends to be pedunculated. The sacrum is broader below than above, with high coequal spines and composed of from four to five elements. The caudal vertebrae form a curved axis directed ventrad. The scapula with coracoid having a long process at the free end directed backward. The spine with nodule or facet-like process at the middle. The superior angle incurved and bears a process which deepens the subscapular fossa. The vertebral border depressed at supra-spinatus fossa and elevated at the infra-spinatus fossa. The head of the humerus with an oblique articular surface; the internal tuberosity produced. The epitrochlea prolonged as a short spine; it serves to deepen the trochlea, besides affording attachment to a ligament and muscles. The epicondyle with a small spine anteriorly. The radius with a square shaft and marked with impressions for extensors of the carpus and thumb. The proximal ulnar rudiment is ankylosed to the radius—a slender thread-like shaft ending free at the proximal third of radius; the distal rudiment with a reverted spine. The manus with erect thumb, not disposed to lie with the second digit; the callosity rudimental, if present; not wider than the first phalanx. The second and fifth metacarpal bones stout, the latter shorter than the forearm, and concave on pollical border near the head for the elongated pisiform bone. The second phalanx of the third digit flexed at a right angle in repose and can not be brought to axial line with the first phalanx. In repose the third digit is much longer than the body and inferior extremity. The pectineal spine or the innominate bone reaches the upper lip of the acetabulum; the thyroid foramen is oval; the internal superior spinous process of the ilium is

pointed. Femur with external trochanter triangular, with a horizontal upper border. Radiocarpal pouch defined; palmar folds present. The endopatagium with numerous vertical muscle fascicles, which form a curved diminishing series toward the manus. The membranes stretched across from the ventral borders of the large, distinct metacarpals. The occipito-pollical muscle receives an accession from the pectoralis muscle; it is held firmly at the forearm to the fascia over the extensor muscles. The cerebrum is acuminate; cerebellum is with lateral lobe (flocculus).

Maxillary incisors two, conical, touching canines, protocone small, with trace only of posterior commissure; third upper molar rudimental; first upper premolar minute and lies inside axis of dental series.

Atalapha is the most aberrant of any of the genera of the *Vespertilionidae*, as this family is at present defined. It presents features in common with the *Molossi* and the *Phyllostomidae*. The shape of the wing, especially as to the strength of the first metacarpal bone, the shortness of the fifth metacarpal bone as compared to others of its series, the rigidity of the phalanges of the fifth digit, the arrangement of the lines in the fourth interdigital space, the flexibility of the lips, the great height of the internal tuberosity and of the length of the epicondyle of the humerus, the reverted distal ulnar rudiment, the posterior deviation of the coracoid process, the presence of a distinct lateral lobe to the cerebellum, the number of the upper incisors (being restricted to two), and the general shape of the wing are as in *Molossi*; while the complete tympanic bone (forming a ring at the upper margin), the pisiform bone being palmar and articulating with the fifth metacarpal bone, the palmar distinctness of the metacarpal bones, the shapes and relative proportions of the ectoturbinals, the presence of numerous vertical raised muscle-bands on the endopatagium, the angle of the lower jaw not being deflected, but remaining in axial line with that of the horizontal ramus, the genus resemble the true *Phyllostomidae*.

The following key will be of use in determining the species:

I. Border of ear light brown; no clumps of hair on forearm.

a. External basal lobe of ear notched *A. noveboracensis* [p. 142].

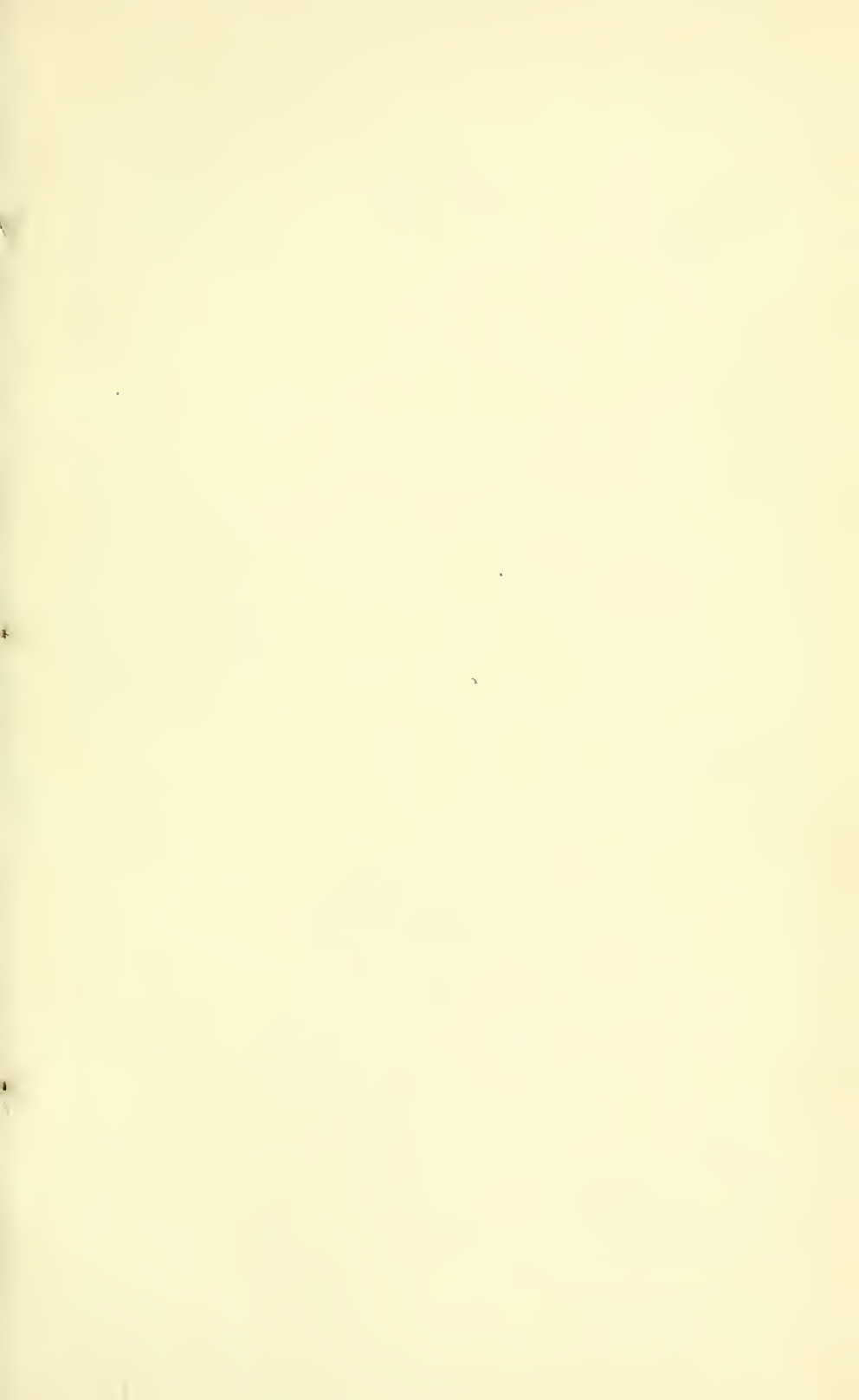
b. External basal lobe of ear not notched *A. teliotis* [p. 153].

II. Border of ear black; a clump of hair on dorsum of forearm ... *A. cinerea* [p. 155].

***Atalapha noveboracensis* (Erxleben).** The Red Bat. (Plates XXVI, XXVII, XXVIII.)

Vespertilio noveboracensis Erxl., Syst. Reg. Anim., 1777, 135; Harlan, Fauna Amer., 1825, 20; Godman, Amer. Nat. Hist., 1, 1826, 50; Cooper, Ann. Lyc. Nat. Hist. N. Y., 1837, 57; De Kay, Nat. Hist. N. Y. (Zool.), 1842, 6, pl. ii; Leconte, Proc. Acad. Nat. Sci. Phila., 1855, 432.

Nycticejus noveboracensis Leconte, Cuv. Regn. Anim. (McMurtrie's ed.), Appendix, 1831, 432; Temminck, Monog. Mam., II, 1835, 158. Wagner, Schreb. Säugeth., Suppl., 1, 1840, 546; *Ib.*, v, 1855, 773. Schinz, Synopsis Mam., 1, 1844, 199; Max. zu Wied, Archiv Naturgesch., 1861, 186.



EXPLANATION OF PLATE XXVI.

- FIG. 1. Front view of head of *Atalapha noreboracensis*.
FIG. 2. Side view of same.
FIG. 3. View of tragus and inner surface of auricle.
FIG. 4. Wing membrane.
FIG. 5. Tail and interfemoral membrane.
FIG. 6. Skull seen from above. x 2.
FIG. 7. Skull and lower jaw seen from the side. x 2.
FIG. 8. Os petrosa. x 4.



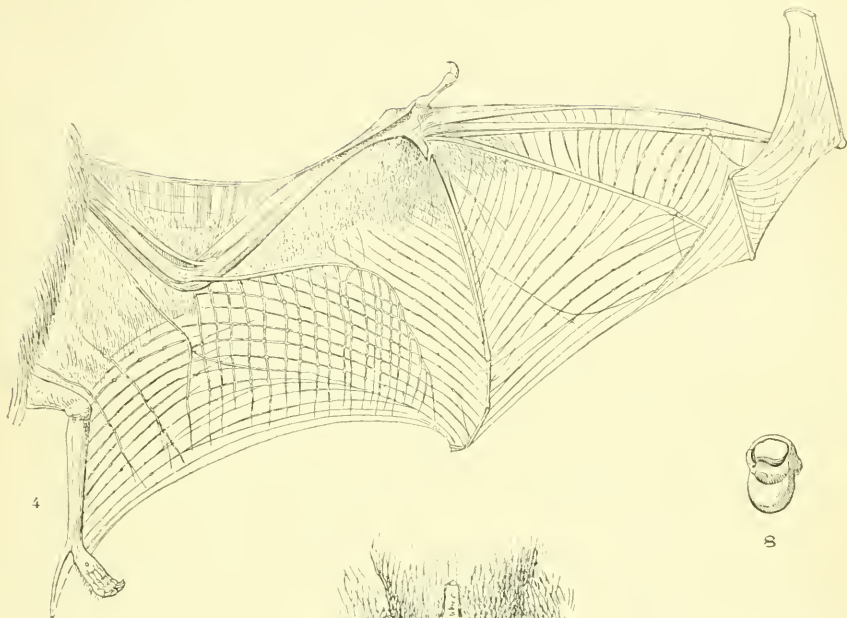
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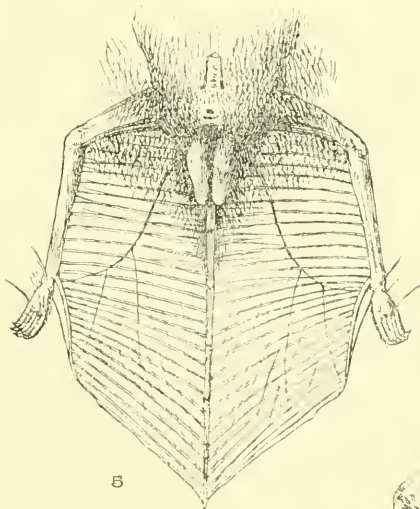
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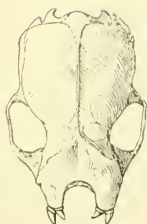
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8



7

- Lasiurus noveboracensis* Tones, Proc. Zool. Soc. London, 1857, 31.
Vespertilio lasiurus Gmel. Linn. Syst. Nat., 1788; Schreb. Säug., 1826; Geoff. Annal. du Mus., Paris, VIII. 1806, 200. f. 6; Desm. Mamm., 1820, 142; Fisch., Synop. Mam., 1829, 109.
Nycticejus lasiurus Wagner, Schreb. Säugeth., Suppl., v., 1855, 772.
Vespertilio rubellus Palisot de Beauvois, Cat. Peale's Mus., 1796, 201.
*Vespertilio villosissimus** Geoff., Annal. du Mus., Paris, VIII. 1806, 478; Desmarest. Mam., 1830, 143; Fischer Synop. Mamm., 1829, 110; Rengger, Säugeth. Parag., 1830, 83; Wagner, Schreb., Säugeth., Suppl. I, 1840, 536.
Vespertilio monachus Raf., Amer. Month. Mag., IV, 1817, 445.
Vespertilio tessellatus, Ibid., Amer. Month. Mag. IV, 1817, 445.
Taphyous rufus Harlan. Fauna Amer., 1825, 23.
Vespertilio rufus Warden, Descript. United States, v. 602.
Lasiurus rufus Gray, List. Mam. Brit. Mus., 1843, 32; Gosse, Naturalist in Jamaica, 1851, 280.
Vespertilio blossomfieldi Lesson et Garnot, Bull. des Sci. Nat., VIII. 95; Fisch. Synop. Mam., 1829, 110; La Sagra, Hist. de l'île de Cuba, 1840, 6, pl. i, f. 4, 5, 6, 7, 8.
Vespertilio bonariensis Lesson, Voy. de la Coquille, I, 1829, 137.
Nycticejus variis Poeppig, Reise Chili, I, 1835, 451; Wagner, Suppl. Schreb. Säugeth., I, 1840, 547; Gay, Hist. de Chili (Zool.), I, 1848, 37.
Atalapha Mexicana Saussure, Revue et Mag. de Zool., XIII, 1861, 97.
Atalapha varia Peters, MB. Akad. Berlin, 1870, 909.
Atalapha frantzii Peters, MB. Akad. Berlin, 1870, 908.
Atalapha pfeifferi Gundlach, MB. Akad. Berlin, 1861, 152.
Atalapha noveboracensis Peters, MB. Akad. Berlin, 1870, 908; Dobson, Cat. Chirop. Brit. Mus., 1878; Coles, Jordan's Man. N. A. Vert.; Alston, Biol. Central-Amer., 1879-1882, 22; Coles and Yarrow, Wheeler's Expedition, Zool., 1875, 1875.
New York Bat. Penn. Syn. Quad., 1771, 367. Encycloped. Methodique. (Dau-benton), 1783, fig.; Penn. Aret. Zool., 1792, 184; Kirtland, Zool. Report 18—, 175, Emmons, Mass. Report, 1840, 9.
Red Bat. Wilson Ornith., VI, 50, f. 4.

Diagnosis.—Much smaller than *A. cinerea*, which it otherwise closely resembles. The hair is reddish with fawn and chocolate variants. There is no clump of hair above the dorsal aspect of the elbow, and the forearm measures from 36^{mm} to 38^{mm}. The border of the auricle is brown and the external basal lobe is notched.

The phalanges in each digit, with the exception of the first, nearly the same length.

The manual formula is as follows:

	Millimeters.
First interspace.....	10
Second interspace.....	33
Difference.....	23
Forearm.....	37

* The tragus in this species is described by its proposer as subulate. The hair extends on the dorsum of interfemoral membrane. But it is not mentioned to what degree. The membrane are pietose. The form is quite as likely to be a variety of *V. albescens* as one of *Atalapha*. (See p. 87.)

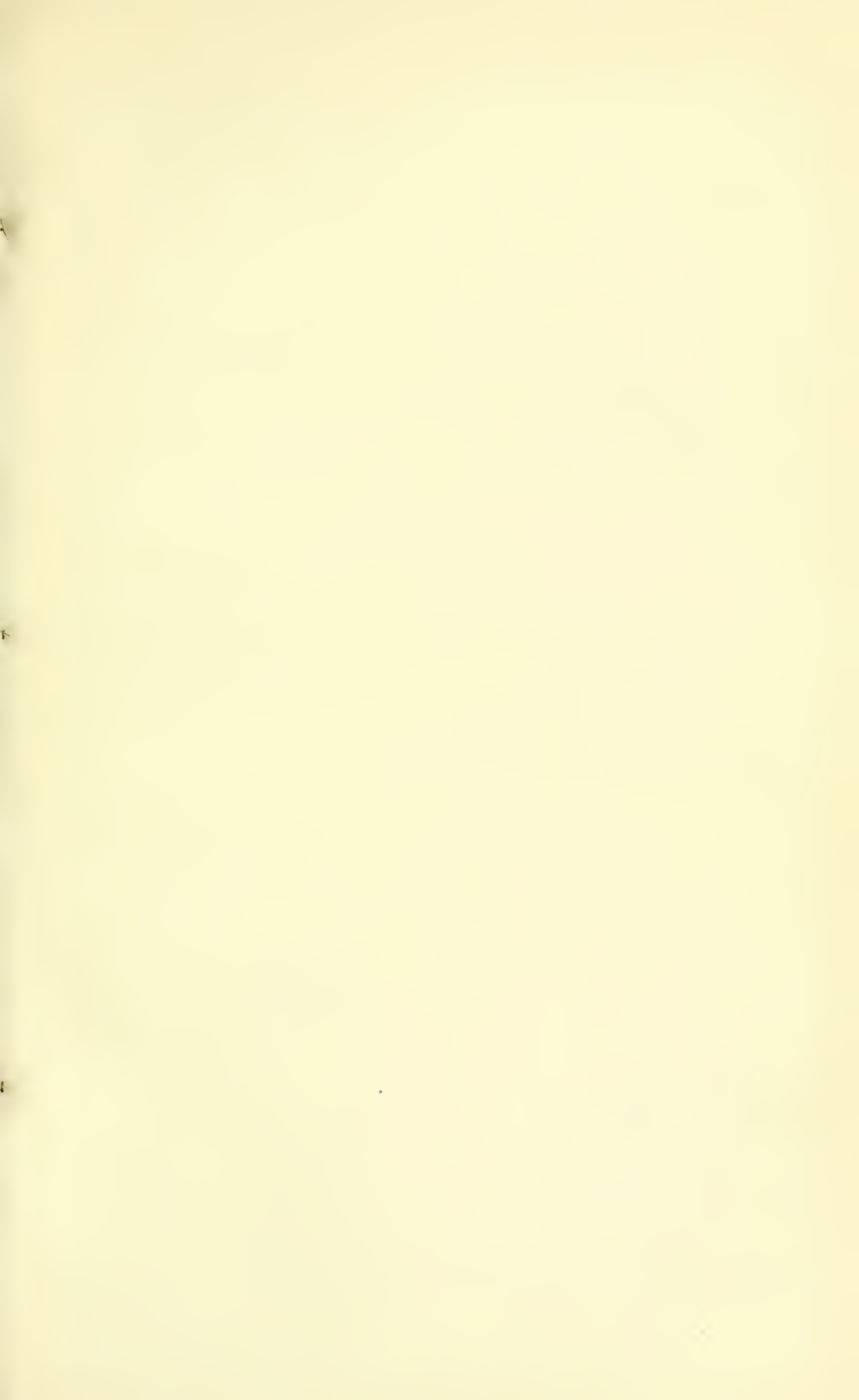
Description.—Ears shorter than head; less rounded than in *A. cinerea*.* While anterior border is convex the posterior is slightly concave between the tip and couch and minutely revolute. The internal basal lobe is wider than high, lower border horizontal, posterior end free and projecting back of the base of the keel (int. basal ridge). The keel is stout and conspicuous. The external basal ridge defined. A narrow hem confined to the region of the shallow notch which it entirely occupies. The external basal lobe rounded not incurved or thickened; a distinct notch at the base anteriorly. The tragus nearly half as high as the auricle. Anterior border nearly or quite straight, tip rounded and produced forward. The greatest width equals one-half the height. The basal lobe is conspicuous; above it lies a long shallow notch, the upper border of which forms a minute tubercle; above this the border is convex but tapers abruptly toward the apex. The tragus is marked by a transverse ridge, which, however, does not extend entirely across the outer surface.

The muzzle is flat or concave, and projects slightly beyond the lower lip. The nostril near the upper lip with septum touching the outer wall. The simple chin plate not bound to the gum nor defined at the sides, but continues with the border of the lower lip. It is apt to be more conspicuous in the female and have a sharply limited lower border.

The calcar is bony in adult forms. It often ends by a small distinct lobe. The post calcaneal lobe is often absent. The wing membrane is attached to the base of the toes. White spaces occupy the side of the fourth and fifth metacarpal bones. Numerous minute spots are dispersed over the third and fourth digital interspaces.

The fur is everywhere soft, luxuriant, and more brilliant in coloring than in any other species in the fauna. Above the general effect is of a russet red color with occasional shades of brown, fawn, dull buff, or gray. The hair of the body is everywhere black at the basal third, followed by a bright, broad band of light buff (gold or yellow); then follows a subtip of the characteristic line of red or its variant, the extreme tip of the hair being often gray, especially toward the sides of the body. The hair is relatively short on the head and neck, and longer on the back of the chest, side of the neck, and over the loin. The ears are covered at the basal two-thirds with fine unicolored hair of the same hue as that of the head; thus the color of the back (at the ear) is brought around to the side and even to the front of the neck. The interfemoral membrane is completely covered in the majority of specimens with hair which is slightly woolly in texture and is without the black base and buff of the shaft that is so conspicuous in the hair of the body. The wing membrane is covered with hair from a point midway from the elbow to the ankle. Like that on the interfemoral membrane,

* In the drawing of the head by M. Dugès, pl. xxvii fig. 2 the ears are represented as bordered by a broad dark margin. Nothing similar to this has been observed by me in the study of the alcoholic specimens.



EXPLANATION OF PLATE XXVII.

- FIG. 1. *Atalapha noveboracensis* hanging by hind feet. The hairy interfemoral membrane is bent forward by the flexure of the tail. After a sketch from life by M. Dugés.
- FIG. 2. Head of *Atalapha noveboracensis*, showing the protruding snout. After a sketch from life by M. Dugés.
- FIG. 3. Front view of head of *Atalapha teliotis*.
- FIG. 4. Skull seen from above. x 2.
- FIG. 5. Skull and lower jaw seen from the side. x 2.



1, 2. *ATALAPHA NOVEBORACENSIS*.

3, 4, 5. *ATALAPHA TELIOTIS*.



The basal black is here absent. The back of the foot is covered with fur of the same character as on the interfemoral membrane. A patch of white hair is seen overlying the first metacarpal bone.

The abrupt contrast seen at the side of the neck between the dorsal and the ventral colors, the long stretch of the dorsal color that covers the ear and extends with its lower forward curve to near the angle of the mouth, the raised longitudinal fold of integument, tend to make this part of the body of special interest.

On the venter the hair is not of the uniform shade of the dorsum, but presents two divisions, the first in the region of the space beneath the jaws and in front of the neck; the second, that of the front of the chest, the abdomen, and the pubis. The first is of a delicate shade of russet red, verging to yellow; the second is of a grayer or whiter tinge, especially at the tips of the hair. The sides are often pure salmon. The basal black and shaft of buff are the same as on the dorsum, but the long gray tip is best developed on the venter. The salmon-tinted hairs of the side are without yellow on the shafts and are often without gray tips. A conspicuous white patch is seen on the venter of prebrachium as this membrane joins the body. In some individuals a ring like band of white is continuous with these patches across the pectoral region. The sides of the neck are particularly richly colored for the red and white effects are here abruptly demarcated. In Southern examples the gray of the abdomen predominates over the red and salmon. In Mexican varieties the entire venter assumes a gray tinge with warm sienna brown interspersed. The hair of the membranes is less developed on the interfemoral membrane, but is more developed on the wing membrane than is the case on the dorsum. On the interfemoral membrane short, woolly, sparsely arranged unicolorous fur is seen at the basal half only. From the knee the same character of fur extends to the third digit from the side of the body for a distance equal to one-third of the width of the wing. The color is dull salmon.

The varieties of coloration are found in the subtip and tip of the hair; they may be named the red, the dark brown, and the gray. The red is confined to the subtip and is accompanied with a bright buff shaft and no ashy tip or so slight a disposition to ash as not to interfere with the prevalent color. The dark brown retains a dull old gold or ochraceous shaft, with a subtip of this color or of old gold; in this variety the membranes are from dark brown to nearly black; the gray color, to a gray-brown subtip, a fawn shaft, and a long gray tip; no ashy hue is anywhere seen.

These differences do not correlate with any structural peculiarities or with contrasts in measurements. Unfortunately many of the more striking are from examples which are without locality. One gray specimen was from Louisiana. In a specimen from Mount Pleasant, sent me for inspection by Mr. G. S. Miller, jr., the colors were somber, being of a dull maroon mottled with black, remarkably like the display of colors in *A. semota*, from the Sandwich Islands.

In the immature individual the hair is without the basal black. On the dorsum the tips are more ashy than in the adult. In some specimens the gray tints predominate along the entire hair. In other examples the basal parts are light brown or reddish brown. On the venter the parts below the line of the head are entirely white over the chest in very young animals, the abdomen being naked. In older forms the basal parts are brown; the sides of the trunk are lined nearly as far back as the spine, much as in *Chilonycteis dargi*. The ears are hairy with the exception of the tips. The deep conch, as it turns on the neck, is heavily covered with hair of the dorsal hues. The hair on the interfemoral membrane and the white spots on the first and fifth metacarpals are as in the adult, but the hair along the forearm is absent.

In an embryo 26^{mm} long, from vertex to pubis was, with the exception of a little hair on the lower lip, naked on the under surface of the body. The color of the skin was of a delicate salmon. On the back, including the interfemoral membrane, the hair was short, uniform, and of a chestnut-brown color, with ashy tips, excepting the margin of the trunk, where the hair was white. On the head a fold extended obliquely forward and inward and almost joined a corresponding band from the ear of the opposite side. The skin of the side of the neck over the position of the tendon of the occipito-pollical muscle was conspicuously raised. In another example of the same size the coloration was the same, excepting that the junction of the side of the neck and the region of the shoulder (ventral aspect) was covered with short, white hair.

Variations.—No. 9050 U. S. N. M.; skin, nearly adult; without locality, is of a uniform gray at the subtip. The absence of the characteristic russet and chocolate tints easily distinguishes this form. It probably is from a northern locality. The specimen is in bad condition. Specimen No. 11153 U. S. N. M., skin, from Arizona or Nevada, Wheeler's expedition (?), does not appear to differ from the eastern examples. The Mexican and California varieties are smaller, with a redder color posteriorly and a gray hue anteriorly. The shoulder tuft is more distinctly ventral. The ventral aspect of the interfemoral membrane is less hairy at the base than are the northern forms, while the hair about the interior extremity extends farther on the endopatagium.

An example from Guanajuato, Mexico, in the collection of Mr. H. A. Ward (No. 14296), resembles *A. frantzii*, Peters. The venter is covered with silky fur, plumbeous at basal half, and whitish or gray at apical half. The fur on the membrane is grayish.

Two examples from Florida, in the Museum of Comparative Zoölogy, are darker throughout than the above description. The external basal lobe was larger, the first phalanx of the second shorter, finger and the external border of the auricle slightly emarginate. The specimens are immature and much mutilated with shot. They may represent *A. Pfeifferi* (?). Mr. C. F. Maynard, l. c., mentions that specimens from

Florida are not only smaller in size than those from the North, but are much deeper in color: the fur is generally tipped with ash.

The extent to which hair is distributed over the skin expanse is subject to considerable variation. It is scantily present over the dorsum of the interfemoral membrane and the ventral region of the forearm in all the specimens (three in number) which have been collected in California. In this particular such specimens resemble the parts as found in *D. ega*, Gervais and *D. egregia*, Peters. It is possible that the Mexican *A. frantzii* may range northward as far as California. In specimen No. 1421 from Massachusetts, in the Museum of Comparative Zoölogy, the hair is restricted in almost precisely the same manner as in the western and neotropical varieties. It is interesting to notice the persistence of the minute tufts of hair on the first and fifth metacarpal elements. These appear early in the individual, while the other growths appear late, and are hence subject to a greater range of variation. The size of the post-calcaneal lobule varies, and in some specimens it is absent. Dobson states that it is always absent. The prebrachial membrane is as a rule ample, but it may end on the radius at a point at the beginning of the distal fourth of the radius. When the membrane is scant the auricle is thick and well set. It is suggestive that in the Molossi when the auricle is thick and leathery the antibrachial membrane is also small.

It is evident from the above account that extended series from the entire continent will be necessary before the observer can determine the validity of species which have been described from Mexico and South America. From the material at my disposal I prefer to accept but two red bats in the United States, *A. noveboracensis* and *A. teliotis*, though holding as probable that a distinct species may be discovered in Florida. The figure drawn by M. Dugès (Pl. XXVII, fig. 2) exhibits the auricle bordered by a broad margin of a contrasting shade to that of the interior, as in *A. cinerea* and the tragus not incurved. It is probable that the fur conceals the external basal lobe, as here represented.

Maj. Le Conte mentions having met with an entirely white form, the bases of the hair alone being dark. It was probably an albino.

In a specimen from Cambridge, Mass., in the collection from Mr. G. S. Miller, jr., the internal basil lobe ends abruptly at the outer end of the internal basil ridge, and is sparsely covered with hair on the conchal surface.

So acute an observer as Mr. J. A. Allen believed, in 1869 (Bull. Mus. Comp. Zoöl., 1869, 143), that the red and hoary bat may yet prove to be one and the same species. In this opinion I can not concur.

Membranes.—The membranes are attached almost to the back of the trunk. The prebrachium forms a ridge at the side of the neck over the occipito-pollical muscle. The thumb is disposed to be drawn palmar by the trachim of this muscle, but to a much less degree than in species of Phyllostomidae. The thumb callosity is not wider than the adjacent

phalanx. The membrane is drawn evenly across the dorsal borders of the digit, so that the bones project palmar only. The third metacarpal bone is here as distinct as any others of its series. The proximal fourth of the fifth metacarpal bone is concealed by palmar folds.

When the lines of the membranes are studied they are seen to be much the same as in *A. cinerea*, with the exception of the intercostal lines, which are more distinct than in that species, and the horizontal limbs of the triceps fascicle system are farther apart. The third interspace is without predigital lines. The terminal digit of the fourth finger is without projecting lobe; that of the fifth finger is minute. The prebrachium with two elliptical thickenings in the line of the tendon of the occipito-pollical muscle; one of these lies at the shoulder, the other along the line of the forearm.

Skull.—The brain case is much elevated posteriorly and abruptly inclines downward toward the face; no depression on vertex between mesencephalon and metencephalon. Processes and crests as a rule produced. The sagittal temporal crest is short and nearly confined to the interval between the metencephalon and the mesencephalon. The posterior temporal ridge is well defined and extends obliquely from the end of the sagittal, thus leaving a large triangle between the two crests and the occipital crest. The anterior temporal crests are faintly defined. The metencephalon is a third of the entire length of the head. The swelling of the protencephalon is distinctly seen on the vertex. The vertex of the face is provided with a wide groove its entire length; there is no nasal eminence. A rounded ridge is seen on each side on the line of the single incisor. The outer wall of the infra-orbital canal is elevated into a tubercle. The lachrymal bone bears a distinct though small spine. The fronto-maxillary inflation is moderate and the inner wall of the orbit flat. The zygomatic arch is slender and of uniform width, *i.e.*, is without elevation of the upper border. The paroccipital process is nearly as long as the occipital condyle; the mastoid process is nearly as long as the paroccipital; the lower border of the interval is deeply notched. The tympanic ring is complete. The angle of the lower jaw is entirely outside the condyle, as seen from above. The masseter impression is not defined inferiorly and reaches the inferior impression of the horizontal ramus.

The details of the cribriform plate and the ethmoidal turbinal plates are as follows:

The encranial surface presents the septoturbinal foramina placed in a row along the anterior half of the space of the same name. The openings of the ectoturbinal surface are in a direct line with the foregoing, and both are depressed below the general surface. The foramen for the first endoturbinal is seen lying at the bottom of the conspicuous depression near the crista galli. The foramina are everywhere at the sides of the encranial surface. Seen from the nasal aspect the ectoturbinal seems to be nearly the length of the first endoturbinal, and is com-

pressed medio-laterally. It is slightly convolute outward at its base and concave on its lateral surface. The first endoturbinial is abruptly acuminate anteriorly, and straight on its median, lateral, and under free surfaces, the last named being concave inferiorly. The second endoturbinial plate is oblique, and slightly inflated at its anterior end. Its lower border forms the inferior edge of the median series of plates. The third endoturbinial is triangular in shape, and is one-half the size of the preceding.

Teeth.—Teeth the same as in *A. cinerea*, with the exception the lower incisors are less crowded and serrate throughout. Some specimens show a degree of crowding greater than that exhibited in the drawing. The anterior prolongation on the lingual aspect of the lower second premolar is somewhat exaggerated. The incision between the paraconid and hypoconid does not reach to the level of the basal cingula.*

The milk upper incisors are carried outward, canine form, and four in number. The lower incisors are unequal, the first tooth being the smallest and simplest, the third the largest and most complex. The lower canine is curved backward and furnished with a large basal cusp.

Mr. G. S. Miller has sent me, from Nassau, a skull of *A. noreboracensis* possessing the remarkable peculiarity of the left maxillary incisor having two distinct cusps instead of one. Close examination was required before it could be seen that two left incisors were not present.

Notes on the skeleton.—The end of the coracoid process of the scapula is scarcely wider than the base; the spine is but little curved and is furnished with a tubercle at the middle. The region of the semicircular canals of the bony labyrinth is scarcely wider than the cochlea, and is without lateral expansion. The epicondyle of the humerus is produced as a spine. The sternum is provided with a large ventral crest at the anterior third of the prosternum; the lateral process is one-half the length of this segment. The distal rudiment of the ulna is in the form of a reverted spine, which is occasionally united to a crest projecting from the radius, thus converting the notch that is defined between the ulna and the radius into a foramen. The radius is quadrate, in transverse sections; it retains a groove for the extensor tendons. The pectineal spine is quadrate and as high as the upper border of the acetabulum. The calcareus is firmly osseous. The fourth metacarpal bone is not concealed when the third and fifth bones are approximated; the first metacarpal bone lies near the center of the carpal region; the second metacarpal is broad and stout, resulting in defining a small second space between it and the second metacarpal.

Remarks on sex.—The females as a rule are a little larger than the males, and, when fully adult, retain at the lower border of the chin-

* Maj. John Leconte (Proc. Acad. Nat. Sci. Phila., 1853), in describing the teeth of this species, states that the canine is hollowed out behind, with a perpendicular septum dividing the concavity for its whole length. The premolars are concave on the outer and inner surfaces.

plate a sharper border, which extends slightly along the lip; the tongue and the terminal caudal vertebra are also somewhat longer. It is probably true that these characters are tactile in significance and relate to the delivery and care of the young. From the marked flexibility of the tail the interfemoral membrane is brought well to the front. The head can with ease be depressed into the pocket in this way formed, and the mother can easily guide the young with her mobile lips to the mammary glands. While this conclusion is of the nature of a surmise, it is made tenable by the structure of the parts involved in the act.

The prepuce is thick, cauliflower-like.

The females are more often preserved in the museums than the males; whether this is due to the greater abundance of females or for some peculiarities which render their capture more easy, is impossible to say.

The mammary glands are rudimental in the female between periods of sexual activity. The mammary region is covered with fur of the same character as seen elsewhere on the front of the thorax. Neither in a female, which possessed embryos two lines in length, is there any external development. If such a specimen be dissected the locality of a mere trace of the gland can be detected by the position of a small circular spot of dark skin, which retains a central white point. No mammary structure will be visible. The lactating female, however, possesses large mammae; one of these lies on the border of the axilla and a second over the pectoral muscle.

The testicles are black. The prepuce is thick and cauliflower-like.

Habitat.—The red bat has an extensive range, even assuming that the species of the tropical and neotropical regions are distinct. According to J. B. Tyrrell (Cat. of Mam. of Canada, Toronto, 1888) it is found throughout Canada, from the Atlantic to the Pacific coasts. In the United States it appears to be more common in the valley of the Mississippi and in the Atlantic slope than on the western plateau. According to C. Hart Merriam (*l. c.*) it is rare in the Adirondack Mountains. To the west of the Sierras it is not common. But two specimens were sent me from the local collection of the California Academy of Science. In the Museum of the Smithsonian Institution in 1865 there was but a single specimen from this region. This was secured at Fort Tejon.

C. F. Maynard, in his paper entitled "Mammalia of Florida" (*l. c.*), says that this species is common in the more northern sections of the State, frequenting the woods. During the day the bats are seen clinging head downward from the leaves of trees. The animal has been captured in the eastern United States while hanging in the manner described. These observations harmonize with the rudimental metacarpophalangeal callosity of the first digit and the great length of the third digit, which can not in repose be dorsiflexed at the phalanges. Nevertheless specimens have been obtained from a cave near Albany,

N. Y., by G. J. Green, and the collection of the Museum of Comparative Zoölogy contains a specimen (No. 5991) which was secured in Short Cave, Kentucky.

J. G. Shute, of Woburn, Mass., observed soon after sunset in October a strange object pass him in the air which seemed to fall to the ground not far from where he was standing. He found it to be a pair of red bats *in coitu*. (J. A. Allen, Bull. Mus. Comp. Zoöl., 1869.)

From the drawing by M. Dugès (Pl. XXVII, fig. 1), which was sent by him to Prof. Baird, it can be inferred that the animal while at rest may bring the interfemoral membrane forward and upward over the abdomen. I have elsewhere ventured to suggest that the female may insert the head into the pouch in this way formed to assist in the delivery of her young and to care for them afterwards. In a second drawing the snout (see Pl. XXVII, fig. 2) is represented as protruding. It is noticeable that the mouth is not wide open and that no teeth are visible.

The red bat may fly over wide ranges of open water, since a specimen now in the Museum of Comparative Zoölogy was caught at sea near Cashes Ledge. The disposition for bats to fly over the water has been often noted; they not only collect the dipterous and neuropterous insects which there abound, but when at rest hang from a branch or twig on the edge of a bank with their snouts nearly touching the water. (Merriam.)

The following table includes measurements of very young individuals with deciduous teeth:

	728. M. C. Z.	No number. U. S. N. M.	No number. U. S. N. M.
Head.....	11	14	15
Body.....	15	25	26
Forearm.....	10	19	28½
First metacarpal bone—first digit.....	2½	3	3
Phalanx.....	4	5	6
Tibia.....	7	10	12
Foot.....	7	7½	7

In these three individuals, whose forms are, respectively, 10, 19, and 28½, the foot remains essentially unchanged, and is the same in the smallest specimen as in the adult. In the first of the series the tibia and foot are of the same length. The bone grows rapidly, and is over twice the length of the foot in the adult. The body and the forearm grow in about the same ratio, and change much more rapidly than does the head.

Measurements.

	mm.	mm.
Head and body (from crown of head to base of tail).....		
Length of arm.....	23	
Length of forearm.....	38	35
First digit:		
Length of first metacarpal bone.....	2	3-4
Length of first phalanx.....	5	5
Length of second phalanx.....	2	2
Second digit:		
Length of second metacarpal bone.....	39	35
Length of first phalanx.....	8	
Third digit:		
Length of third metacarpal bone.....	40	39
Length of first phalanx.....	17	17
Length of second phalanx.....	17	16½
Fourth digit:		
Length of fourth metacarpal bone.....	37	39
Length of first phalanx.....	12	11½
Length of second phalanx.....	10	8
Fifth digit:		
Length of fifth metacarpal bone.....	36	32½
Length of first phalanx.....	6	7
Length of second phalanx.....	9	4½
Length of head.....	17	
Height of ear from head.....	6	
Height of tragus.....		
Length of thigh.....	19	16
Length of tibia.....	17	15
Length of foot.....	7	
Length of tail.....	36	

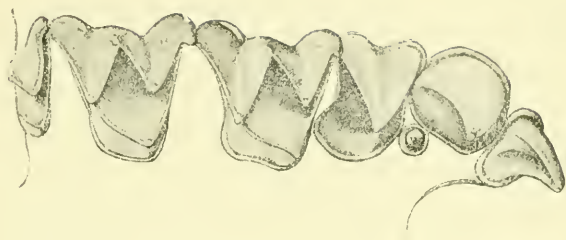
* Lactating.

Measurements from first edition of *Monograph*.

Current number.	From tip of nose to tail.	Length of tail.	Length of forearm.	Length of tibia.	Length of longest finger.	Length of thumb.	Height of ear.	Height of tragus.	Expanse.
	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>	<i>In.</i>
5266	1.9	2.0	1.6	0.9	3.3	0.4½	0.4	0.2	10.9
5267	1.9	2.0	1.6	0.9	3.5	0.4½	0.6	0.3	12.0
67	2.0	1.9	1.6	0.9	3.0	0.4	0.5	0.3	11.6
.....	2.0	1.9	1.6	0.9	3.5	0.4½	0.4	0.3	12.0
.....	2.0	1.9	1.5	0.9	2.9	0.4	0.5	0.3	11.0
.....	2.0	1.9	1.6	0.9	3.0	0.4½	0.4	0.3	11.0

List of specimens.

Cat. No.	Specimens.	Locality.	Presented by—	Nature of specimen.	Collection.
5242	1	Muskeget Island, Mass.	Dr. T. M. Brewer	In alcohol.	U. S. N. M.
5243	2	Wethersfield, Conn.	Charles Wright	do	Do.
5245	2	Mount Holly, N. J.	Dr. Brown	do	Do.
6188-90	3	Carlisle, Pa.	S. F. Baird	do	Do.
5244	17	do	do	do	Do.
5540	2	Ann Arundel County, Md.	J. H. Clark	do	Do.
5247-8	2	Washington, D. C.	National Institute	do	Do.
5246	1	do	Dr. Nichols	do	Do.
5257	3	Columbus, Ga.	Dr. Gesner	do	Do.
5256	5	Liberty County, Ga.	Dr. W. L. Jones	do	Do.
5263	1	Tallahassee, Fla.	T. Glover	do	Do.
5314	1	Micanopy, Fla.	Dr. J. B. Bean	do	Do.
5260	2	Eutaw, Ala.	Prof. Winchell	do	Do.
5259	1	Washington, Miss.	Col. B. L. C. Wallis	do	Do.
5252	1	do	do	do	Do.
5253	1	Monticello, Miss.	Miss H. Teunison	do	Do.
5464	1	Columbus, Miss.	Dr. Spillman	Dry skin ..	Do.
5261	2	Tyree Springs, Tenn.	Prof. R. Owen	In alcohol	Do.
5262	2	Knoxville, Tenn.	Prof. Mitchell	do	Do.
5274	1	Grand Coteau, La.	St. Charles College, U.S.A.	do	Do.
5270	1	Prairie Mor Rouge, La.	James Fairie	do	Do.
5253	1	Fort Towson, Ark.	Dr. L. A. Edwards	do	Do.
5254	2	Fort Smith, Ark.	Dr. G. C. Shumard	do	Do.
5256	3	Red River, Ark?	(?)	do	Do.



1



2



3

1. MAXILLARY TEETH OF *ATALAPHA NOVEBORACENSIS*. X 16.
2. MANDIBULAR TEETH OF SAME. X 16
3. MAXILLARY INCISOR, CANINE, AND PREMOLARS OF *ATALAPHA TELIOTIS*. X 16.

List of specimens—Continued.

Cat. No.	Specimens.	Locality.	Presented by—	Nature of specimen.	Collection.
5251	1	Cass County, Mo.	Dr. P. R. Hoy	In alcohol ..	U. S. N. M.
5463	1	Missouri	do	Dry skin ..	Do.
5250	14	St. Louis, Mo.	Dr. G. Engeluann	In alcohol ..	Do.
4215	1	Neosho Falls, Kans.	B. F. Goss	Dry skin ...	Do.
5249	6	Illinois	R. Kennicott	do	Do.
5460	1	Cook County, Ill.	do	do	Do.
5457	1	Racine, Wis.	Dr. P. R. Hoy	do	Do.
5459	1	Albion, Mich.	R. R. Child	do	Do.
5456	1	Grosse Isle, Mich.	Rev. Charles Fox	do	Do.
5466	1	Lake Superior	do	do	Do.
5458	1	Yellowstone River	Dr. F. V. Hayden	do	Do.
5461	1	do	Col. Vaughan	In alcohol ..	Do.
5265	1	Nebraska	Dr. J. G. Cooper	do	Do.
5264	1	Laramie Peak, Nebr.	Dr. Hayden	do	Do.
5278	1	Cimarron River, Kans.	J. H. Clark	do	Do.
5269	1	Pecos River, Tex.	Capt. J. Pope	do	Do.
5272	3	Bet. Laredo & Camargo, Tex.	Arthur Schott	do	Do.
5277	5	Matamoras	Lieut. Conch (Berl. Col.) ..	do	Do.
5268	1	Fort Bliss, N. Mex.	Lieut. S. W. Crawford	do	Do.
5266	1	Fort Tejon, Cal.	John Xantus	do	Do.
5267	1	Cape St. Lucas	do	do	Do.
5273	1	Rock Creek?	W. S. Wood	do	Do.
5279	1	Locality unknown	do	do	Do.
5275	1	do	do	do	Do.
6185-7	3	do	do	do	Do.
5271	1	do	do	do	Do.
5541	1	do	W. L. Le Duc	do	Do.

2. *Atalapha teliotis* H. Allen. (Plates XXVII, XXVIII.)

A. teliotis H. Allen, Proc. Amer. Phil. Soc., XXIX, 1891.

Ears rounded, much smaller than head. The internal basal lobe longer than broad, and without posterior projection. The external basal lobe longer than high, without notch at the base anteriorly. The hem occupying notch is half the height of the auricle and is ample. The tragus is coarsely cremlate on the outer border, slightly narrowed at the tip, which is not turned forward. The external surface is without a trace of ridge, and the notch at the base above the small basal lobe without a tubercle. Snout and lower lip quite as in other species of the genus, except that the chin plate is somewhat wider.

Skull with groove on center of face vertex continuous with the anterior nasal aperture. Sagittal temporal ridge sinuate. The first upper premolar exceedingly minute, scarcely half the size of the corresponding tooth in other species; it can with difficulty be seen even with the aid of a lens. The lower premolars are nearer of a size than is the case in other species, the first being fully half the size of the second. The third lower incisor is rounded, minute, and without cusps.

The membranes are much as in *A. northoracensis*, but the terminal phalanx of the fifth finger is longer and ends with a free end on the margin of the endopatagium. The membranes are attached to the foot at a point midway between ankle and the base of the toes.

The prevalent color of the hair is dark chestnut above, but lighter below. The base on the body is everywhere black, and the shafts buff. No ashy tips are anywhere seen. The ventral half of the side of

neck is white. The hair is scanty along the ventral surface of the forearm and the proximal ends of the last three metacarpals. The dorsum of the interfemoral membrane is furred only at the basal third. The remaining characters as in *A. noreboracensis*.

The manal formula is 2-10-28-37, the difference between the third and fourth interdigital interspace 18, and is much the same as in *A. noreboracensis*.

Teeth.—The teeth, as in other species of the genus, with the exception that the first premolar is smaller and slightly oval, and the second premolar with a narrower V and smaller heel.

This species is readily distinguished by the shape and small size of the ear and tragus, by the attachment of the wing membrane to the foot, and by the peculiarities of the premolars in both jaws, as well as those of the third lower incisors. It agrees with a southern variety of *A. noreboracensis* (*A. frantii*) in the partially free dorsal surface of the interfemoral membrane.

The specimen was forwarded to me by Mr. J. G. Cooper, of the California Academy of Natural Science, in a bottle containing an example of *A. noreboracensis*, and it resembles this form so closely in coloration that at first I mistook it for an immature example of the species last named. The specimen is in poor condition. After decomposition had set in it had been preserved for a long time in strong alcohol.

Habitat.—Unknown, but is probably southern California.

Measurements.

	Millimeters.
Head and body (from crown of head to base of tail).....	38
Length of arm.....	22
Length of forearm.....	37
First digit:	
Length of first metacarpal bone.....	2
Length of first phalanx.....	4
Second digit:	
Length of second metacarpal bone.....	40
Length of first phalanx.....	6
Third digit:	
Length of third metacarpal bone.....	40
Length of first phalanx.....	14
Length of second phalanx.....	15
Fourth digit:	
Length of fourth metacarpal bone.....	38
Length of first phalanx.....	10
Length of second phalanx.....	8
Fifth digit:	
Length of fifth metacarpal bone.....	32
Length of first phalanx.....	7
Length of second phalanx.....	7
Length of head.....	12
Height of ear from head.....	4
Height of ear from base of external lobe to tip.....	6

Measurements—Continued.

	Millimeters.
Height of tragus	3
Length of thigh	14
Length of leg	16
Length of foot	6
Length of tail	39
Width of second interdigital interspace	2
Width of third interdigital interspace	10
Width of fourth interdigital interspace	28
Difference between third and fourth interspace.....	18
Length of forearm	37

The measurement of the body and of the metacarpals are within the range of these which can be made on specimens of *A. noveboracensis*. The second phalanx of the third finger is longer than the second; the second phalanx of the fourth finger is much shorter than the first; the second phalanx of the fifth finger is of the same length as the first. In these respects the measurements are in contrast with those of *A. noveboracensis*. The thigh is shorter than the leg, while both are smaller than is the species named. The foot is shorter, while the tail is slightly longer.

3. *Atalapha cinerea* (Palisot de Beauvois). The Hoary Bat. (Plates XXIX, XXX, XXXI.)

Vespertilio cinereus Palisot de Beauvois, Cat. Peale's Mus., Phila., 1796, 14; Leconte, Proc. Acad. Nat. Sci. Phila., 1855, 433.

Vespertilio pruinus Say, Long's Exped. to Rocky. Mts., 1823, 67; Harlan, Fauna Amer., 1825, 21; *Ib.*, Med. and Phys. Researches, 1831, 28; Godman, Amer. Nat. Hist., 1826, 68, pl. II, f. 3; Richardson, Fauna Boreal. Amer., 1829, 1; Cooper, Ann. Lye. Nat. Hist. N. Y., IV, 1837, 54; DeKay, Nat. Hist. N. Y. (Zool.), 1842, 7, pl. II, f. 2.

Scotophilus pruinus Gray, Mag. Zool. and Bot., II, 1838, 498.

Nyctiejus pruinus Temminck, Monog. Mam., 1835, 154; Wagner's Schreb. Säug. (Suppl.), I, 1840, 544; *Ib.* V, 1855, 770; Schinz, Syn. Mam., I, 1845, 197; Max. Zu, Wied. Archiv Naturgesch., 1861, 185.

Lasiurus pruinus Tomes, Proc. Zool. Soc. Lond., 1857, 37.

Lasiurus cinereus H. Allen, Monog. N. A. Bats, 1864, 21; J. A. Allen, Mammals of Mass., 1869, 208.

Atalapha cinerea Peters, MB. Akad. Berlin, 1870, 910—Dobson, Cat. Chirop. Brit. Mus., 1878, 272—Alston, Biol. Centrali-Amer., 1879-'82, 23.

Diagnosis.—A large bat with rounded black-bordered ears, blunt incurved tragus; external basal lobe without notch; interfemoral membrane hairy above. Color distinctive, being hairy with play of colors of grays and of dull yellow. A clump of hair above the dorsal aspect of elbow. Forearm 54^{mm}.

The second phalanx in each digit shorter than the first.

The manal formula is as follows:

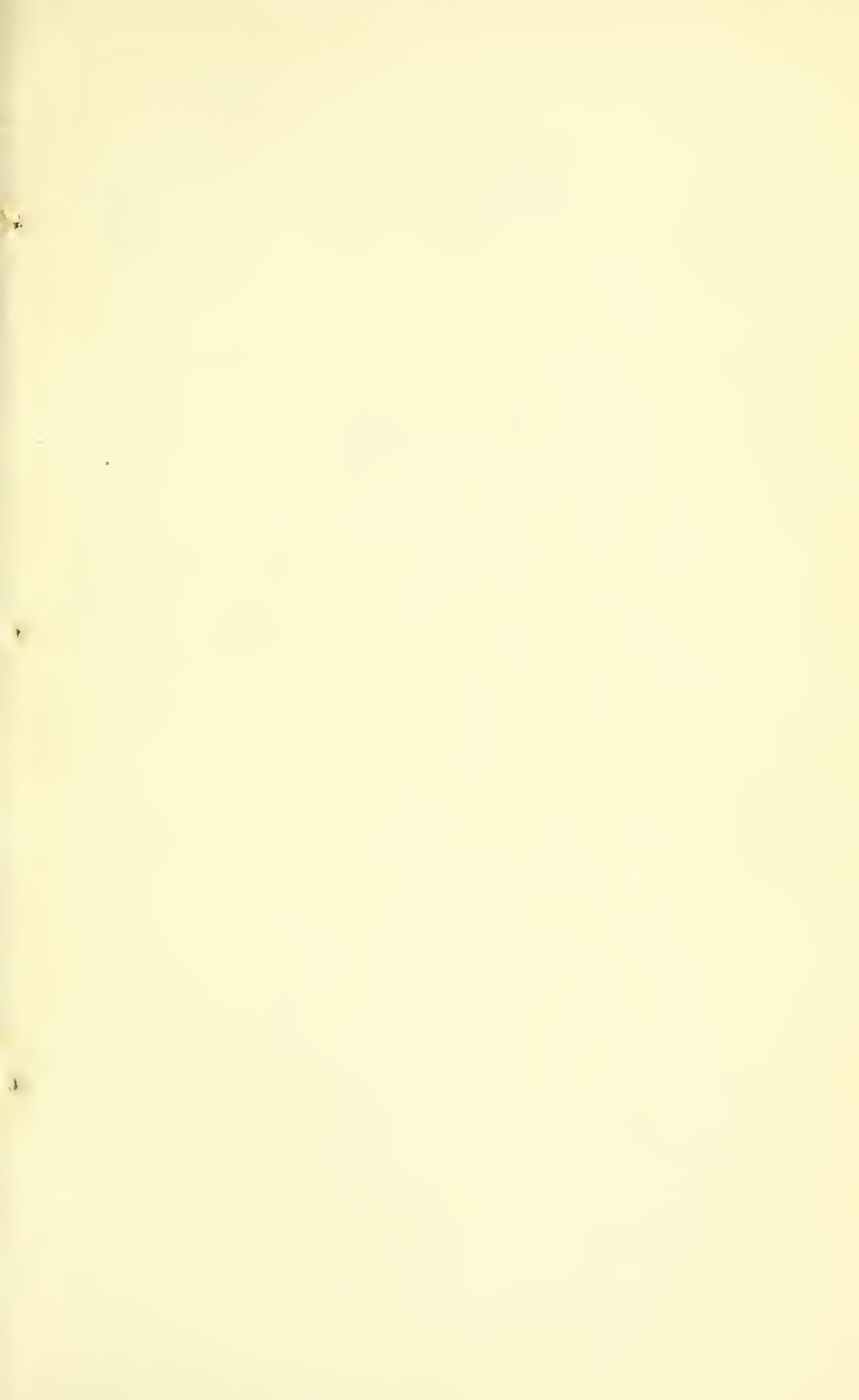
	eters.
Third interspace	13½
Fourth interspace	40
Forearm	49
Differences between third and fourth.....	27

Description.—The auricle is erect, of a subrounded form, and in good specimens marked within by four delicate transverse lines; when pressed on the head the upper border reaches to the median line or extends slightly beyond it. The outer border of the auricle is slightly emarginate and with the exception of the border, is of the color of the wing membranes. The border, as just mentioned, is of a darker hue than the rest of the auricle and is naked, except along the posterior border, where it is furnished with a single row of hairs. The remainder of the auricle is hairy. The internal basal lobe is large and reaches to or conceals the eye; it is as broad as the tragus at its widest part. The lower border is oblique from behind forward. The external basal lobe is also large, not revolute, separated from the main body of the auricle by a deep incisure, in which is lodged the basal lobe of the tragus, but not produced at the anterior border to the extent seen in *A. noveboracensis*. When pressed against the side of the head the upper border touches the internal basal lobe.

The tragus with basal lobe to the outer side of pedicle, which is separated by a deep rounded notch from the main lobe. This notch receives the revoluted border within and below the notch in the auricle. At the widest part the tragus is more than half its height.

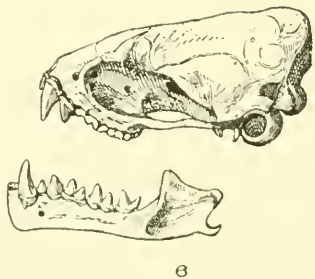
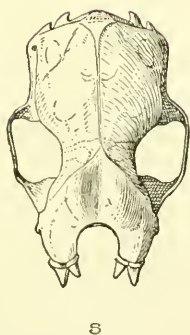
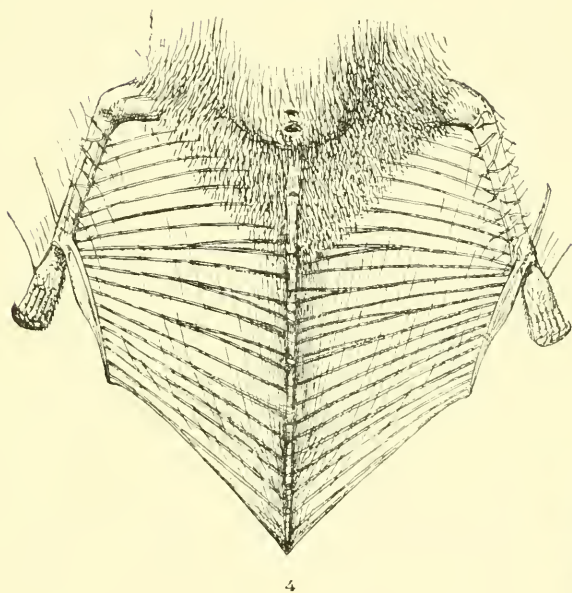
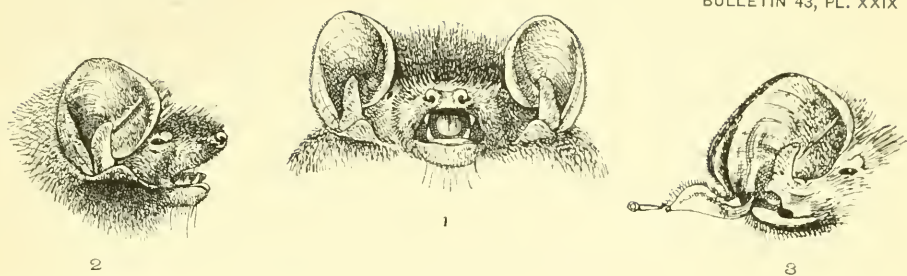
The mouth cleft reaches to the second line of the premolar or to the external canthus. The lower lip is fleshy and not fixed to the gum. Two subrounded, subequal buccal folds are present. A wart is found at the angle of the mouth, and a second back of the chin. The snout is broad, nearly equally in width the length of the mouth cleft, as seen in profile. When the fleshy upper lip is drawn outward the distance between the incisor teeth and the end of the snout is equal to the width of the snout. The nostrils are slightly produced, directed obliquely outward, the space between them concave. The surface is marked by a transverse line of supralabial hairs as in *Molossus*. The rounded shield between the upper incisors separated from the upper lip by a depression.

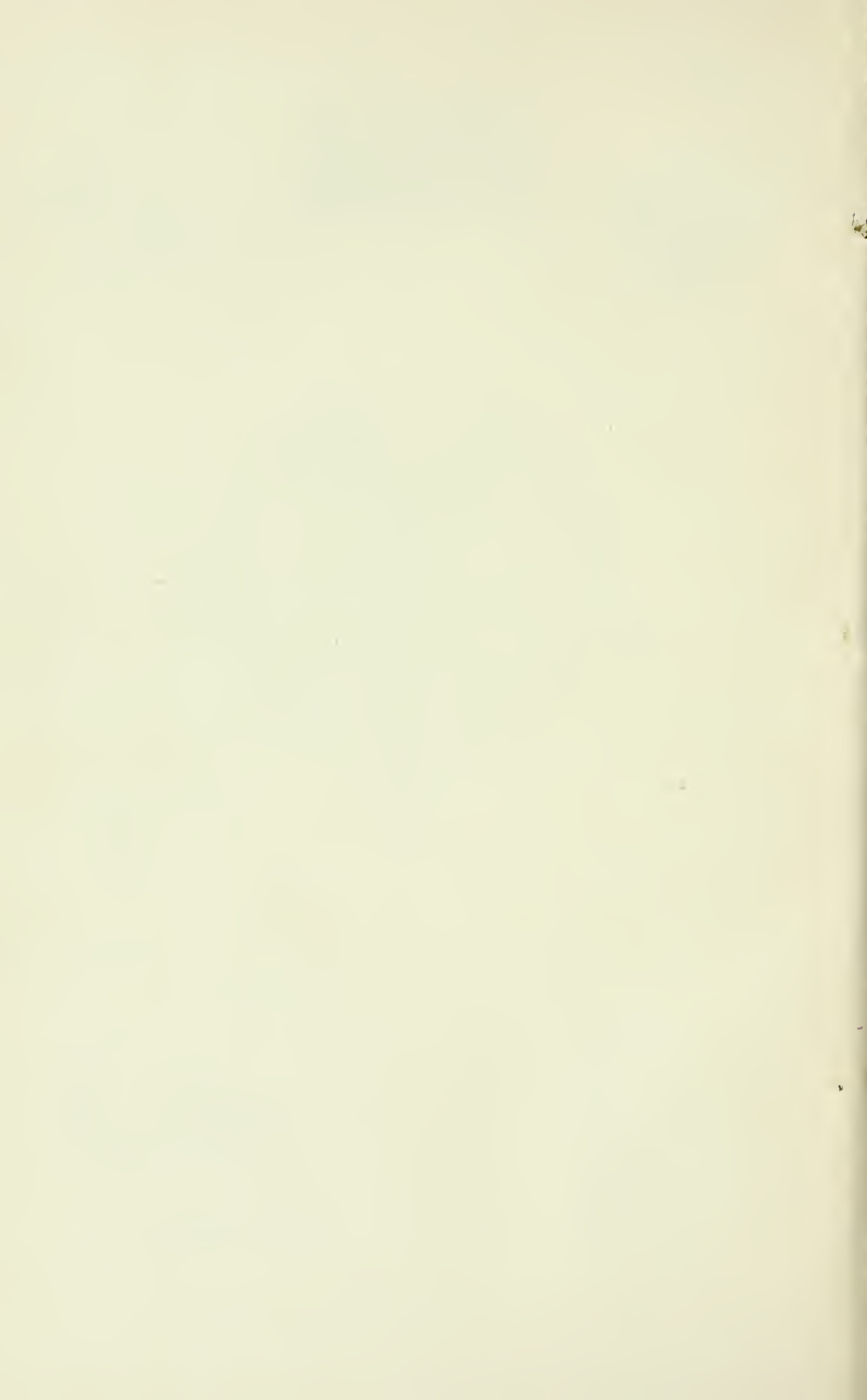
Coloration.—The plan of coloration is the same as in *A. noveboracensis*. On the dorsum of the head and on the ears the hair is light brown to dull yellow, with black base. On the dorsum of the neck and chest the color on the shaft above the basal black is of a dull yellow, to ochre instead of bright yellow; the subtip is deep brown, chocolate, umber, or even black, against which the ashy tip appears to good advantage. The last two colors are conspicuous in the unmanipulated fur, and has caused the name "hoary bat" to be given the species. On the loin the shades are darker than elsewhere. On the venter the hair of the side of the face and beneath the jaws is black. The upper half of the neck is dull yellow, with black base; the lower half of the neck is provided with a deep brown subtip, with slight ashy tip; which character of fur extends over the chest and abdomen. As in *A. noveboracensis*, the line between the neck and the chest is marked by a ring-like disposition of



EXPLANATION OF PLATE XXIX.

- FIG. 1. Front view of head of *Atalapha cinerea*.
FIG. 2. Side view of head of same.
FIG. 3. Side view of tragus and inner surface of auricle.
FIG. 4. Tail and interfemoral membrane.
FIG. 5. Skull seen from above. x 2.
FIG. 6. Skull and lower jaw seen from the side. x 2.
FIG. 7. Os petrosa. x 4.





white tips, which become conspicuous on the ventral aspect of the prebrachium to form the so-called "shoulder tuft." At the pubis, the base of the interfemoral membrane, and along the sides of the trunk, including the axillæ, the hair is silky and without the black base; it is dull brown or cinerous, with a long, ocher tip.

The membranes.—On the dorsum the hair extends from the body as far as a line from the middle of the humerus to the ankle, and thus extends slightly on the membrane beyond the tibia. A distinct patch covers the back of the first metacarpal, the first interdigital space, and the base of the second metacarpal bone; a mere fleck overlies the base of the fifth metacarpal and the forearm near the elbow. On the venter the membranes are covered with short, brown, obscurely bicolored fur from the side of the body, and thence extends in a broad, oblique line as far as the third digit; upon the third interspace it stretches distally for a distance equally one-half the length of the metacarpal bones. The arm is covered, while the forearm is naked. The prebrachium is also furred, save at the free border. The exterior of the auricle is covered with dull yellow or ocher-colored hair, except at the broad, black margin, which, however, bears at the lower part a delicate fringe. The interior of the auricle, both in front and back of the keel, is covered with short hair. The tragus is also slightly furry. The dorsum of the interfemoral membrane is covered throughout with hair of the same character as that of the loin, or with that in which the shaft assumes a darker shade of buff or brown; the ventral aspect of this membrane is furred only at the basal third; the color can not be distinguished from that of the pubis.

Variations.—In No. 13281, U. S. N. M., Utah, the hair on the loin and dorsum of the interfemoral membrane is of a *café au lait* brown instead of the darker shades described in the text.

In No. 4223, U. S. N. M., Petaluma, Cal., and No. 13207, also from California, the shaft of the hair above the basal dark shade is almost white, both on the dorsum head and body and the ventral aspect of the neck. The colors about the face are deep brown instead of black.

In No. 6184, U. S. N. M., British America, the ash tips on the venter are absent except on the mammary lines.

Some of the specimens are more gray on the sides of the neck than others.

The terminal point of the caudal series varies in length from 1^{mm} to 5^{mm}. The prebrachium is small, joining as a rule the proximal half of the forearm. The females as a rule have it somewhat larger than in the males.

The posterior border of the tragus at a point just above the notch is thicker than the rest of the border in No. 5284, U. S. N. M.

Membranes.—The prebrachium without details. The lines of the endopatagium are indistinct, owing to the hairiness of the membranes. The coraco-brachialis fascicle extends to the free margin as in *Miniopterus* and *Emballonura*.

The triceps fascicle system crosses the elbow at origin, is without vertical branch, but yields two horizontal primal branches; these extend across the membrane near each other and appear to end in the abruptly determined comb-like endings which do not reach the region of the phalanges of the fifth finger. There are two oblique lines extending downward and somad from the muscle-mass at distal end of the fifth finger.

The fourth interspace has the predigital nerve, as in *Miniopteris*, while the terminal branches do not reach the digits of the fifth finger, but join a branching nerve which appears from the metacarpo-phalangeal joint of the fourth finger. A small unbranched line (postdigital nerve?) appears at the middle of the fourth metacarpal bone.

Two oblique bands are seen on the fourth interspace near the palm. A fork-like arrangement of lines is seen in the angle between fourth and fifth metacarpal bones, and appears to be a branch of the median dividing into the two branches commonly seen in this interspace. In the third interspace a similar arrangement is seen, but the main nerve pursues a longer course before dividing. At the region of the digits there are two predigital nerves and three postdigitals. In this portion of the membrane, therefore, an unusually large number of lines are seen. It is possible some of these lines pertain to the blood-vessel system.

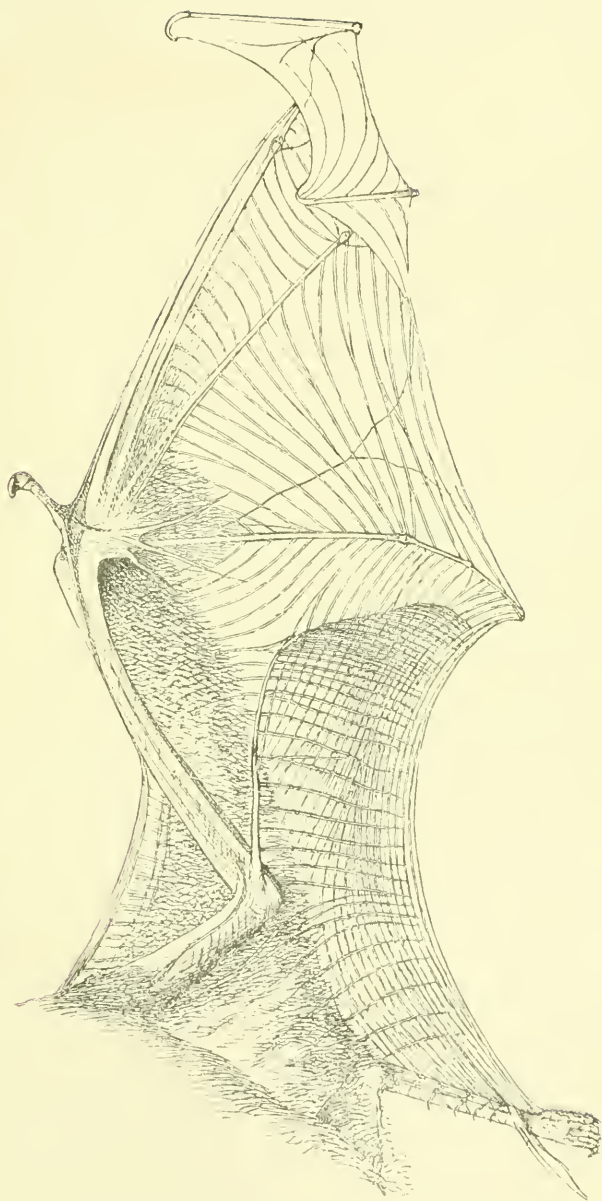
The pelvotibial line is seen on the interfemoral membrane; but the oblique lines from the caudal vertebrae are distinctly visible.

The terminal phalax of the third finger is curved only at the tip, and no part thereof projects; that of the fourth finger is acicular, deflected at a right-angle pollical to the second; it yields a free projecting tip; that of the fifth finger is acicular, is deflected somad and inclosed only on this side.

The membrane of the first interspace can be discerned everywhere along the line of the wing, except at part of the first phalax of the third digit.

Skull.—Length, $16\frac{1}{2}$ ^{mm}; greatest width, $9\frac{1}{2}$ ^{mm}; least width, 5^{mm}. The sagittal crest is limited, and ends on the anterior third of the mesencephalon. The posterior temporal crest is faintly expressed. Face in advance of orbit 2^{mm}. The occipital crest is interrupted in the center. No tubercle is present over the proencephalic foramina. The vertex of the face provided with a wide depression which extends to the anterior nasal aperture. The fronto-maxillary inflation is conspicuous, extending back of the anterior temporal impression and forming an elevation at the side of the vertex depression. The orbital ridge is small and distinct, is placed well forward, and terminates posteriorly by a tubercle. The inner wall of the orbit is concave; a second tubercle lies directly back of the large lachrymal canal.

The paroccipital process is large, spinous, and is directed obliquely downward and backward for nearly the length of the condyle. The



WING MEMBRANE OF *ATALAPHA CINEREA*.

mastoid process is well defined, and is slightly produced downward. The interval is smooth, but is deeply incised inferiorly. The line of the superior border of the anterior nasal aperture, if produced, would intersect the first molar. The hard palate is inclined upward. The glenoid cavity has a semblance of a pedicle. The pterygoid process is broad and conspicuously produced. The tympanic bone conceals the cochlea. The bony labyrinth being removed, the region of the semicircular canals is seen to be wider than the cochlea.

The coronoid process is rudimental, and but half the height of the horizontal ramus. The masseric impression involves the coronoid and reaches to the inferior border of the ramus. The angle is flat and does not reach the line of the condyle, and is slightly deflected, so, when seen above, is found to lie to the outer side of the condyle. A well-defined post-symphysal rugosity is present.

The general plan of the ethmoid plates resembles that of *A. noveboracensis*. The parts are, however, of greater height, the interval between the first and second endoturbinals being wider. The second endoturbinal is relatively larger, and curved outward. This arrangement causes the plate to present a concave surface outward, which receives the swollen lower border of the third plate. The median aspect of the first endoturbinal is straight; but the lateral surface is deflected outward, and is impressed on its entire surface by the ectoturbinal which rests upon it, leaving only a raised rim of the endoturbinal round its anterior half. The median surface of the produced portion of the first endoturbinal is nearly as high as it is long. The concave under surface embraces securely the maxilloturbinal.

Maxillary teeth.—The single incisor adjoins the canine and projecting slightly forward and inward. The median surface deeply and sharply excavated and is in contour with the palatal notch. The canine is wedged in between the incisor and the second premolar, posteriorly fluted. Cingulum is entire; median excavation present. The first premolar is minute, conical, placed well to inner side of the axis of tooth row. The second premolar with broad cingulum, with scarcely perceptible protocone, deeply fluted on buccal surface. The first molar resembling *Nyctinomus*. The protocone is of low development, much as in *Macerotus*, but is acutely pointed at apex with oblique palatal surface, the posterior commissure obscurely defined on the posterior aspect of tooth, apparently not reaching beyond the apex of the second V. The first V smaller than the second and more deeply fluted on buccal surface. Cingulum defined, but hypocone absent. The second molar much the same as the first; the Vs are subequal. The third molar rudimental. The protocone and commissures are defined, but the posterior limit of the first is imperfect, being defective in buccal half, while the second V is absent.

Mandibular teeth.—The incisors are crowded; the first is the widest and coarsely serrate at the cutting edge, the second and third blunter

and less compressed, the posterior basal swelling marked in all. The canine slightly inclined backward, concave on posterior surface. The cingulum entire. The premolars unequal, the first much the smaller. The first and second molars with the anterior limb of the heel joining the smaller V at about the middle of the posterior limb. The commissure on the lingual surface of the heel oblique from behind forward. The third molar with a scarcely triangular heel, which is smaller than the V, blunt, compressed.

Notes on the skeleton.—Atlas with sharply produced downward transverse process, which bears a single foramen. The process back of the transverse process of the presternum equals the length of the process in front of the same. The mesosternum scarcely crested.

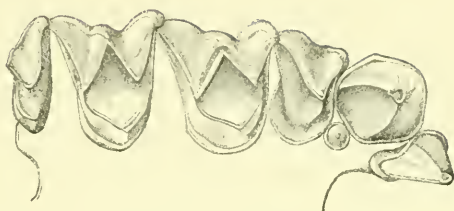
The coracoid process of scapula does not reach to the middle of the glenoid cavity. The end of the process is twice the width of the base; the long process from the scapula spine is greatly curved, and is abruptly widened in the middle. The axillary border resembles that in *Molossus rufus* in being straight for over half its length, and in being thence gradually inclined outward. The upper border is at the superior angle, furnished with a conspicuous spine, which projects toward the glenoid region and lies below the level of the base of the coracoid. The infraspinous fossa is without ridge between the surfaces for the infraspinatus and teres minor muscles; a ridge lies in the subscapular fossa. A facet is seen on the axillary side of the acromion. The clavicle is stouter than in most bats of the size and is more curved than in *Artibeus*, with which it answers in general size.

The humerus with internal tuberosity much higher than the head. The radius is about one and a half times as long as the humerus. The proximal border is produced so as to partake of the olecranon function of supporting the elbow posteriorly; on the articular surface a deep, narrow groove is bounded by flanges. The distal end with a broad, thin process on the flexor surface directed downward and inward. The outer border is produced, truncate, and appears on the under surface of the bone. The proximal ulnar rudiment does not extend distally beyond the lower border of the depression for the insertion of the biceps muscle; the distal ulnar rudiment is provided with a groove for the flexor tendons.

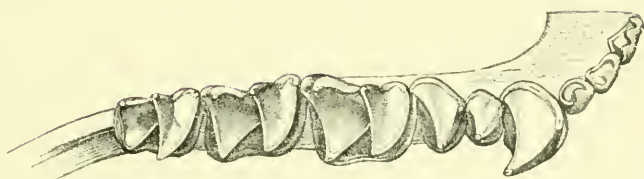
The carpus does not possess characters distinct from *A. noveboracensis*. The third metacarpal bone with two grooves entire length on one side and one groove on the other.

The first phalanx of the second finger one-fifth the length of the corresponding metacarpal bone. The second phalanges of the third and fourth fingers are slightly longer than the first.

The fifth digit varies slightly as compared with the length of the forearm. No. 5284, U. S. N. M., Nebraska; it lacks one-fifth (*i. e.*, 2) of being as long as the forearm. In No. 3215, U. S. N. M., it lacks but



1



2

1. MAXILLARY TEETH OF *ATALAPHA CINEREA*. X 8.
2. MANDIBULAR TEETH OF SAME. 8 X.



one-sixth. In the former specimen the fourth metacarpal bone is 2^{mm} longer than the forearm; in the latter it is just as long.

Remarks on sex.—The prebrachial membrane is smaller in the female than in the male, and stops at the distal fourth of fifth of the forearm. In one example only of nine specimens of females examined was a large antebrachial membrane present. Of three males examined two have large antibrachial membranes which extend free to the thumb, while the third terminates at the distal fifth of the forearm. The auricle is thicker in the female than in the male. The penis is furnished with a cauliform prepuce.

Habitat.—According to Le Conte, *A. cinerea* is more common in the Northern than in the Middle or Southern States. Judging from the numbers found in collections, it is a rare bat in the far West. J. B. Tyrrell (*l. c.*) states that it is found in Canada from Nova Scotia to Manitoba. Richardson (*American Borealis*, 1829, 11) obtained it on the Red River in British North America at an altitude of 54°. It is likely that it frequents mountain ranges and table-lands in preference to river valleys or coastwise regions. Mr. Thomas Say reports (*Long's Expedition to Rocky Mountains*, 1823, 1, 167) its collection at Council Bluffs, Iowa. Say (*l. c.*) mentions that Prof. Barton presented a specimen of this bat to the Philadelphia Museum that had been captured in Philadelphia.

C. Hart Merriam (*Mammals of the Adirondaeks Region*, 1886, 176) notes that the flight in this species is swift and irregular. The nightly range is greater than in any member of the fauna. Whenever the temperature of the air is above 59° F. it may be seen on the wing. Like many bats, it is active just before evening and at dawn. It has been caught hanging from a twig of a tree as in the case of *A. noveboracensis*. When kept in confinement it suspends itself by the claws of the feet.

Measurements taken as an average of four individuals.

	Millimeters.
Head and body (from crown of head to base of tail).....	68
Length of arm.....	37
Length of forearm.....	54
First digit:	
Length of first metacarpal bone.....	4
Length of first phalanx.....	8
Second digit:	
Length of second metacarpal bone.....	59
Length of first phalanx.....	8
Third digit:	
Length of third metacarpal bone.....	60
Length of first phalanx.....	19
Length of second phalanx.....	23
Fourth digit:	
Length of fourth metacarpal bone.....	53
Length of first phalanx.....	11
Length of second phalanx.....	13

Fifth digit:

Length of fifth metacarpal bone.....	45
Length of first phalanx.....	7
Length of second phalanx.....	9
Length of head.....	24
Height of ear.....	15
Height of tragus.....	8
Length of thigh.....	16
Length of tibia.....	22
Length of foot.....	11
Length of tail.....	47

Measurements from first edition of Monograph.

Current number.	From tip of nose to tail.	Length of tail.	Length of forearm.	Length of tibia.	Length of longest finger.	Length of thumb.	Height of ear.	Height of tragus.	Expanse.
	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>	<i>Inches.</i>
5280	3.0	2.4	2.0	1.0	4.3	0.6	0.6	0.4	15.3
14 (?)	3.0	2.5	2.2	1.0	4.1	0.7	0.6½	0.4	14.9
147	2.6	1.8	2.0	0.11	4.0	0.6	0.4	0.3	13.4
3255	.....	.....	2.0	1.0	4.1	0.6	0.4	0.3	12.6
40	3.0	2.0	2.0	0.10	4.2	0.6	0.4	0.4	13.6
4213	2.6	2.0	2.0	0.10	4.2	0.6	.....	.....	13.6
4728	.....	.....	2.0	0.8	3.9	0.7	0.3½	0.3	11.6
269	2.0	2.0	2.0	0.11	4.0	0.6	0.3	0.2½	12.6
3098	2.0	.....	2.0	0.10	4.0	0.7	0.4	0.2½	.....
1743	2.0	2.0	2.0	0.10	3.8	0.6	0.4	0.3	10.0
73	2.6	2.0	2.0	0.12	4.0	0.6	0.4	0.3	12.0
93	3.0	.....	2.0	0.11	4.0	0.6	.....	0.4	11.6
873	2.6	2.0	2.0	0.11	4.0	0.6	0.4	0.3	12.6
883	2.6	2.0	2.0	0.12	4.1	0.6	0.4	0.3	14.0
415	2.6	2.0	2.0	0.10	4.0	0.6	0.4	0.3	14.0

List of specimens.

Cat. No.	No. of specimen.	Locality.	Presented by—	Nature of specimen.	Collection.
5280	1	Halifax, N. S.	Dr. Gilpin	Alcoholic.	U. S. N. M.
6184	1	British America.....	R. Kennicott	do	Do.
5286	1	Red River settlement.....	D. Gunn	do	Do.
5417	1	Cleveland, Ohio	Dr. Kirtland	Dry	Do.
5421	1	Little Blue, Kans.....	W. S. Wood	do	Do.
5281	2	St. Louis, Mo.	Dr. G. Engelmann	Alcoholic.	Do.
5283	1	Grand Coteau, La	St. Charles College	do	Do.
5328	2	Fort Pierre, N. Mex.....	D. J. Evans	do	Do.
5284	2	Near Fort Union, N. Mex.....	Dr. Hayden	do	Do.
5422	1	Fort Pierre, Nebr.....	do	Dry	Do.
4213	1	Neosho Falls, Kans.....	B. F. Goss	do	Do.
5415	1	South Fork Platte	F. V. Hayden, MD., U. S. A. (?)	do	Do.
3768	1	La Boute River, Utah.....	(?)	do	Do.
5414	1	Donna Anna, N. Mex.....	Dr. T. C. Henry	do	Do.
5282	5	Matamoros	Lieut. Couch, Berlin College	Alcoholic.	Do.
4728	1	"United States" .....	.....	Dry	Do.
5286	2	Monterey, Cal.....	A. S. Taylor	Alcoholic.	Do.
5287	1	Petaluma, Cal.....	E. Samuels	do	Do.

Group MOLOSSI.*

* MOLOSSI.—So intimate is the relation between this group and the Vespertilionidæ that I decline to give it the value of a family. The characteristics elsewhere noted are here taxonomically arranged. It appears to be subordinated to the Vespertilionidæ, and for the present, at least, I shall place it as an alliance thereto. The Molossi, like the Vespertilionidæ, are adapted to cosmopolitan range by the adaptation to both terrestrial and aerial locomotion. The wing is stout, narrow, and muscular.

With the Vespertilionidæ the ethmoidal plates are volute, the trapezium is fur-

Genus **NYCTINOMUS** Geoffroy.

Nyctinomus Geoffroy, Descript. de l'Egypte, II 1812, 114; H. Allen, Monog. N. A. Bats, 1864, 5; Dobson, Cat. Chiropt. Brit. Mus., 1878, 137; Alston, Biolog. Centrali-Amer., Mamm., 1879-82, 33.

This genus is in close relation with *Molossus*. It is distinguished by the absence of union of the palatal plates of the premaxilla. Teeth with large hypocone. Auricle with internal basal ridge, developed into a well defined "keel;" the external basal ridge continuous with an erect external basal lobe. Auricle quadrate; metacarpo phalangeal joint of third and fourth digits mobile, bent forward; the interphalangeal joint of the same digits mobile, bent backward (these digits when extended reach far below the level of the toes); the joints of the fifth digit rigid and in line with the metacarpal. The second metacarpal lies palmar to the third; the phalanx is rudimental or absent.

Nyctinomus is of wide distribution, examples being found in all parts of subtropical and tropical regions. With the exception of *N. norfolcensis* (Australia, Norfolk Island) and *N. johorensis* (Malay Peninsula), the species are singularly alike in essential features. A critical examination of all the species is demanded before the exact position of the North American forms can be determined.

The North American species considered in the following pages are *N. brasiliensis* and *N. macrotis*. I have not seen *N. femorosaccus* Merriam (N. A. Fauna, No. 2, 1889, p. 23), or *N. mohavensis*, Merriam (N. A. Fauna, No. 2, 1889, p. 23), both from southern California. (See Appendix.

1. *Nyctinomus brasiliensis* Isid. Geoffroy. (Plates XXXII, XXXIII.)

Molossus nasutus Spix, Sim. et Vesp. Bras., 1823, 60, pl. XXXV, fig. 7; *vide* Isis, August, 1824, 899 (Brazil); Schinz, Syn. Mamm. I, 1844, 113.

Dysops nasutus Temminck, Mon. Mamm. I, 1827, 234, *ib.*, Zool. Jour., III, 1828, 159; Wagner, Schreb., Säugeth., Suppl. I, 1844, 474; *ib.* v. 1855, 741.

nished with a palmar tubercle, and the coracoid process is always bifid, the posterior portion being prolonged.

A large spheno-palatine foramen is present, while the presence of palatal processes to the premaxilla is detected in most of the genera. The tail is always produced well beyond the interfemoral membrane, and the accessory cartilage is absent from the short, rigid fifth digit.

The groups of the Molossi constitute a subfamily characterized by the narrow wing, prominent thumb, free terete tail, and the rigidity of the short fifth digit. The group at one end recalls the subfamily Emballaurinae in the dorsal flexion and adduction of the metacarpo-phalangeal and interphalangeal joints of the third digit, characters it possesses in common with most forms of the Emballaurinae. The types of upper molar, namely, in the presence of a hypocone, is also met with in *Emballaura*. The last upper molar in both groups exhibits a nearly perfect second V. The large hypoconoid in the last lower molar is repeated in all the emballaurines including *Euria*. Adaptation to active motion with wing at rest is seen in all. The greatest degree of the adaptation last named is seen in *Cheiromeles* of Borneo, though the other genera of the group are rapid flyers.

Nyctinomus nasutus (snouty bat), Tomes, Proc. Zool. Soc. London, 1861, 68 (Jamaica).

H. Allen Monog. N. A. Bats, 1864, 7.

Nyctinomus brasiliensis Isid. Geoff., Annal. des Sci. Nat., 1, April, 1824, 337, pl. xxii (Brazil); *ib.*, Zool., Journ., 1, 1825, 133; Ferussac, Bull. des Sci. Nat., 11, 1824, 74; Dobson, Cat. Chiropt. Brit. Mus., 1879, 437; Alston, Biolog. Centrali-Amer., 1879-82, 33.

Nyctinomus murinus Gray, Griffith's Cuv. An. Kingdom, v., 1828, 66.

Nycticea cynocephala Leconte, Cuv. An. Kingdom (McMurtrie's ed.), 1, 1831, 432 (South Carolina).

Molossus cynocephala Cooper, Ann. Lyc. Nat. His. N. Y., LV, 1837, 65, pl. iii, fig. 1; Wagner, Schreb., Säugeth., Suppl. V, 1855, 714.

Molossus fuliginosus Cooper, Ann. Lyc. Nat. His. N. Y., LV, 1837, 59, pl. iii, fig. 3 (South Carolina).

Rhinopoma carolinensis Gundlach, Archiv f. Naturgesch., 1840, 358, (not of Geoff., in Desm. Mam., 1820, 130, and Dict. d'Hist. Nat., XLV, 1829); Leconte, Proc. Acad. Nat. Sci. Phila., VII, 1855, 437.

(?) *Dysops nasus* Wagner, Schreb., Säugeth., Suppl. 1, 1840, 475.

(?) *Nyctinomus mexicanus* and *N. aztecus*, Sauss., Rev. et Mag. de Zool., XI, 1860, 283.

Diagnosis.—Muzzle truncate, with numbers of spines on upper border, but none on the vertical internarial ridge. Spines also on the inner border of the auricle. Dorsum of face furnished with long stout bristles. Fur of a dull mouse gray, paler beneath. The first phalanx in the third, fourth, and fifth digits, exceeds in length the second. Second phalanx of the fourth digit over half the length of the first phalanx. The tail beyond the level of the toes is free.

Description.—The muzzle with a deep emargination between the nostrils. A vertical band without a groove or spine extends on the muzzle to the lip. A small post-mental wart is present. The ears are one-half to 1^{mm} apart on the face.* The median border of the ear is sinuate near its attachment to the head. The outer border is notched at the upper third so that the entire edge may be said to be scalloped; the border below the side of the scallop is thin, and everted as far as the line of the external basal ridge. The border ends abruptly at the anterior edge of the base of the external basal lobe which is broader than high and higher posteriorly than anteriorly. In some specimens the antitragus is continued forward by a skin fold to the angle of the mouth. The notch between the external basal ridge and the external basal lobe is inconspicuous not reaching one-half way to the base. The tragus is quadrate, measuring 4^{mm} along the posterior border and 1½^{mm} along the anterior.

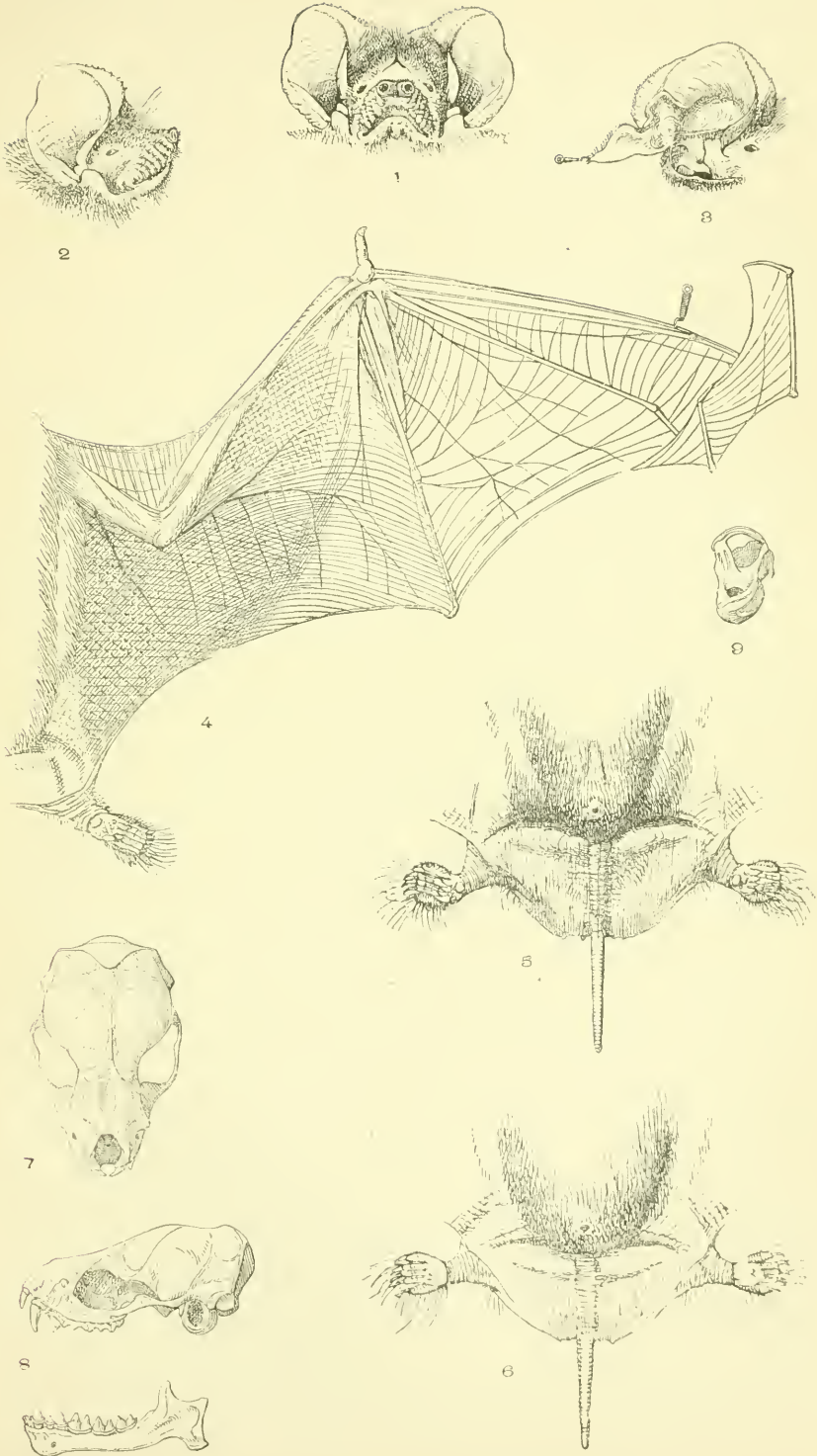
The fur is silky on the back of the head and basal half of ears; the trunk and sides of the neck are plumbeous verging to drab or dusky brown; the base is everywhere white but the extent of the color is variable. On the sides of the neck the white color is most marked, and on the lower part of the back and rump it is least so. A silvery tint is seen on the tips when they are seen in an oblique light. The sides of the trunk are much lighter in hue and are unicolorous. The

*Unless close examination be made the ears appear to be united. Thus Cones and Yarrow (Wheeler's Exped., Zool., 1875) describe them as united over the vertex.



EXPLANATION OF PLATE XXXII.

- FIG. 1. Front view of head of *Nyctinomus brasiliensis*.
FIG. 2. Side view of same.
FIG. 3. View of tragus and inner surface of auricle.
FIG. 4. Wing membrane.
FIG. 5. Tail and interfemoral membrane of *Nyctinomus brasiliensis*, western form.
FIG. 6. Tail and interfemoral membrane of same, eastern form.
FIG. 7. Skull seen from above.
FIG. 8. Skull and lower jaw seen from the side.
FIG. 9. Os petrosa.



fur extends on the membranes from a point at the proximal third of the humerus to the distal two-thirds of the femur and is thicker along the margin than where it is continuous with the body. On the venter the fur is intermediate in shade between that of the back and the side of the trunk. It is either unicolorous or barely white at the base. The pre-brachial membrane is naked or furnished with a small patch of hair.

The face is naked over the dorsal surface except in the space between the median border of the auricle and the nostril where a number of long 3^{mm} to 4^{mm} stout bristles are found.* In the female not infrequently a whitish diffused patch is seen on each side of the neck near the lower jaw. A few long white hairs adorn the pubis. Occasionally the male has a patch similar in color to the above growing on the post-mental space.

Membranes.—The entopatagium without markings from the intercostal or lumbar nerves. The line of the coraco-brachialis fascicle becomes apparent at the middle of the humerus, passes vertically downward medianly to the elbow, and divides, at lower two-thirds of the membrane, into two branches. The lower runs forward to a point lateral to the elbow, *i. e.*, in advance of the joint. The triceps fascicle system with a plexus of superior branches. The terminal part of nerve abruptly deflected downward.

The first oblique band at the radiometacarpal angle is attached to the first metacarpal bone. It crosses the palm obliquely, and reaching the mesopalafium lies for 4^{mm} close to and parallel with the radius. The pouch is distinct. The tendon of the palmar interosseus muscle of the fifth finger makes no impression upon the membrane. A broad, dusky band, apparently due to the membrane becoming contracted in this line, extends obliquely from the lower end of the tibia to the wrist. It is conspicuously seen in all specimens which are held up to a strong transmitted light.

The fourth interspace shows a nerve appearing at the angle anteriorly. This soon divides into two branches, a posterior and an anterior. The posterior passes obliquely across the membrane to reach the fifth finger at the distal third, where it disappears. Before doing so it yields a branch, which is distributed to the posterior half of the membrane. The anterior nerve keeps close to the fourth finger. At its proximal fourth it is lost in the contour of the bone. Just before its termination it sends off a large posterior branch, which, supplies the anterior of the interspace. In the third interspace a long main nerve is seen dividing into two branches. In the second interspace a posterior nerve appears at the proximal third of the first phalanx of the fourth finger, and an anterior from the proximal third of the first phalanx of the third finger. The ectopatagium is attached on the distal end of the second phalanx of the fifth finger, while the mesopatagium

* The bristles about the nostrils have been neglected in describing species of *Nyctinomus*. They are conspicuous in *N. brasiliensis*, while almost absent in *N. plicatus*.

is attached to the tip of the third phalanx, thus the median border of this phalanx is without membrane. The third phalanx is directed obliquely toward the body. The third phalanx of the fourth finger is deflected parallel to the free margin of the membrane of the third interspace away from the body, and presents a well-defined free inferior border. The third phalanx of the third finger exhibits a distinct cutaneous flange or hem on the free border. Thus all the terminal phalanges are in part or in whole free from the wing membrane on one border. The tail membrane with an indistinct band extending from the knee inward from knee one-half the way to the tail. The inferior margin presents a well-marked lobe near the tail.

Variations.—A variety of *Nyctinomus* from California differs from others examined in the presence of plantar tubercles, and in the large size and good definition of the calcaneal tubercle (pl. XXXII, fig. 5). It is further distinguished by the females exhibiting well-defined spines on the median vertical ridge of the muzzle. In the males these are supplanted by small tubercles, or the ridge is entirely smooth. In four examples, three of which were males, the chin was furnished with two small, symmetrically placed warts. No similar appendages have been noted in the genus. In one female an elongated wedge-shape plate defined the mentum. The specimens were 22 in number; males 9, female 18. The females were disposed to be slightly larger than the males, and to possess unusually marked masses of fat in the anterior abdominal wall and at the groin. Should increased knowledge of this variety make it desirable to assign it a distinct name it may be regarded as *Nyctinomus brasiliensis californicus*.

The assertion that the ears are disunited is sustained by many examinations. However, in a specimen (No. 6045, Mus. Comp. Zoöl.) the ears are united by a band 1^{mm} high.

In three specimens from the island of St. Kitts (6019, 6020, 6021 Mus. Comp. Zoöl.) the tail was free for 9^{mm} only.

N. pumilus, from the Bogas country, Africa, resembles the species last named in the length of the second phalanx of the fourth finger, such length being over twice the length of the corresponding phalanx in other species of the genus examined. One female of this species has been examined from the collections of the Museum of Comparative Zoölogy.

The following observations on this species may be of use in studying *N. brasiliensis*: The muzzle is without spines. The lips are much thicker than in *N. brasiliensis*; they are wider than the muzzle is high. The few stout bristles on the face are much less conspicuous than in *N. brasiliensis*. The ears are united for a height of 4^{mm}. The keel of the auricle is 5^{mm} long. The ears are rounded without a scallop on posterior border; the free portion below the head measures 6^{mm}. The antitragus is higher than broad and is 4^{mm} wide at the base. The sides

of the tragus are of equal height, quadrate, and measure a little less than 1^{mm} in all proportions. They are directed obliquely backward, so that the upper border is vertical. On the mesopatagium the first oblique band is small and indistinct. It is attached to the side of the fifth metacarpal bone (*i. e.*, it is free from the muscle mass). The pouch is indistinct. The submentum is provided with a distinct wart, but no median ridge lies between the wart and the lower lip, as in *N. brasiliensis*.

Maxillary teeth.—The incisor of each side is slender, simple, obliquely directed downward and inward, but not touching its fellow. A wide space exists between it and the canine. The canine is slender, vertical, scarcely produced beyond the second premolar; cingulum produced posteriorly. To the outer side of this prolongation, but set in slightly from the outer limit of the tooth series, is seen the minute first premolar. The second premolar with well-defined protocone and fluted paracone—the heel-like projection of the cingulum is discernible. The first molar possesses a sharply defined acute protocone of low elevation, the commissures embracing the two *v*'s. The paracone is slightly smaller than the metacone. The hypocone unusually well defined, often almost as high as the protocone and sometimes bilobed. The second molar as the first, but with equal cusps and simple hypocone. The third molar with protocone as in other molars. The anterior *V* slightly compressed. The posterior *V* with anterior limb entire; posterior limb absent. The molars do not touch except at their buccal surfaces.

Mandibular teeth.—The incisors, three in number, the first and second equal or subequal, bilobed, without basal cusps. The third much smaller, wedged in between the second and the canine, and is often lost. The canine with sharply defined cingulum entirely round the tooth. The premolars slightly crowded, the first the smaller. Of the molars the *V* is smaller than the heel throughout. The anterior limb of the heel adjusts against the *V* at about its middle. The triangle composed of paraconid, metaconid, and protoconid is much compressed from before backward. The paraconid not inclined forward as is seen to be the case in *Atalapha* and *Macrotus*. The commissure at the base of the heel is conspicuously cuspidate. In the third molar it, in addition, bears a second small acicule. The cingulum is visible throughout at the base on the buccal surface.

Skull.—Greatest length, 15^{mm}; greatest width, 10^{mm}; least width, 4^{mm}; length of face from orbit, 3½^{mm}; distance from infraorbital foramen, to the tooth row, 1^{mm}. The sagittal crest is defined the entire length; weaker posteriorly. The posterior temporal crest is trenchant, forming with its fellow the sides of a broad-based triangle, 2^{mm} long. The mesencephalon is 3^{mm} long. The anterior temporal crest ends on the orbital crest, which is sharply outlined and as long as the orbit is high. The inner wall of the orbit is flat. The vertex of the face

provided with a median groove which begins abruptly at the junction of the sagittal with the anterior temporal crests and reaches a point half way to the anterior nasal aperture. The fronto maxillary inflation extends over the entire face vertex. The short infraorbital canal is provided with an elevated ridge-like outer wall, which carries a pit. A large foramen unites the nasal chambers near the posterior nasal aperture with the mesopterygoid fossa. The otic foramen converted into a notch, thus permitting the otic capsule to be exposed the entire length on the side of the skull. The paroccipital process is inconspicuous and ends at a point about on a level with the mastoid process. The interval is occupied entirely by the otic capsule. The tympanic ring is complete. The sphenoidal tongue is rudimentary or absent. The coronoid process is less than half the height of the horizontal ramus. The angle is scarcely produced back of the line of the condyle. The interval between the two is almost straight. The angle is broad, flat, acuminate and is markedly deflected outward so as to be almost free from the line of the condyle when seen from above. The masseteric impression is deep but does not reach the lower border of the ramus. The post-symphysal process is absent. The incisive notch deep as in *vespertilio* and allies.

The following notes will be of interest in connection with the study of the skull of *N. brasiliensis*:

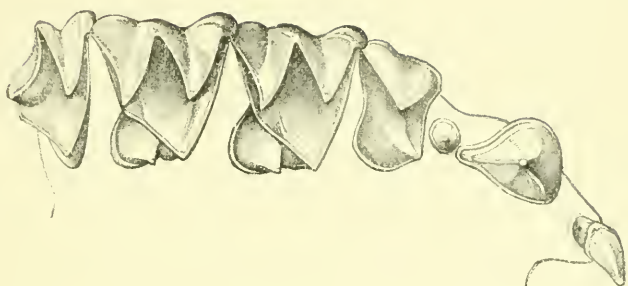
N. orthotis.—The sagitta is well defined. The face vertex is elevated with scarcely any depression. The fronto-maxillary inflation is rudimentary. The zygoma is without elevation on the upper border. The basisphenoid fossa is well marked. The postpalatal spine is absent. The infraorbital canal is long, permitting the line of the anterior nasal aperture to fall back of the facial foramen. The coronoid is less elevated, while the angle is longer and less acuminate, and lies far beyond the condyle.

N. norfolcensis.—The sagittal crest is absent. The face vertex is with shallow depression, but conspicuous orbital ridge and lachrymal tubercle. The coronoid process is high, greatly exceeding the width of the adjacent ramus. The angle is widely deflected from the line of the condyle.

N. europs.—The sagitta is absent. The orbit crest is scarcely defined. The lachrymal tubercle small. The zygoma is without elevation on the upper border. The coronoid process above the line of the condyle is a mere tubercle, and greatly less than the width of the adjacent ramus.

Notes on the skeleton.—Atlas: The lower opening for the vertebral artery is much larger than the upper; below it a spine projects downward and outward.

Scapula: The upper half of the subscapular fossa limited inferiorly by an oblique keel. The vertebral border of this subfossa is concave



1



2

1. MAXILLARY TEETH OF *NYCTINOMUS BRASILIENSIS*. X 12.
2. MANDIBULAR TEETH OF SAME. X 12.

and deepened somad, especially at the angle, where a large recurved process from the border is seen. The coronoid extends toward this process and nearly reaches it; thus the coronoid is not curved downward as in the case generally in other than the molossids. The lower lip of the glenoid cavity projects markedly, making the glenoid very concave; the lateral margin is convex; the median margin is straight. The triceps impression is strictly axillary, with a greater tendency to encroachment on the dorsum.

Humerus: Axis of head very oblique to the axis of the shaft. The pectoral ridge equals one-fifth the length of the shaft. The external tubersity greatly exceeds the inner in height. The epitrochlea is produced as a spine, which reaches below the trochlea. The inner half of the trochlea is scarcely grooved anteriorly.

Ulna: The proximal part of the ulna equals half of the length of the radius; the articular surface bears a longitudinal crest. The distal part form a quadrate imperforate plate.

Pelvis: The innominate bones do not unite at the symphysis. Each bone is firmly ankylosed to the sacrum. The symphysal border is three times as long as the pectineal spine. The thyroid foramen is nearly circular. The sacrum is composed of three elements, the spines of which increase from above downward. The caudal vertebræ are eleven in number. The first two resemble the sacral elements in having broad, flat, conjoined lateral processes. The others are like caudal vertebræ generally in mammals.

Habitat.—Subtropical and tropical America apparently everywhere abundant. It is sometimes so numerous in the Southern cities of the United States as to render houses uninhabitable by their disagreeable odor and the noise they make in moving about.

I had an opportunity in December, 1880, to study a number of living animals which had been collected by Mr. James Bell at Gainesville, Fla., and sent to me by Prof. Baird. They did not resist handling and made no defense. The mouth was not open in excitement, nor was any cry emitted; a slight purring sound was occasionally heard. The feet were used to dress the fur and to scratch; the outer side of the thigh was easily reached by abducting the foot, the last-named act being induced doubtless by the long peroneal muscle, the knee at the same time being moderately flexed. Extension of the wing often occurred (as though in preparation for flight), as terrestrial animals stretch their limbs in arousing from sleep. In such a movement the inferior extremity was abducted by the traction of the fifth finger on the wing membrane. In standing the trunk was prone, the head slightly elevated, the wings folded, the toes separated, the first and fifth toes being farther apart from their neighbors than were the second and third from one another. The foot was dorsiflexed and the plantar surface was on the ground. Walking was accomplished with ease and carried the little creature quickly along. The manus in this act remained folded, and the motion

appeared to be made up of the arm and forearm acting as one factor, the callosity over the first metacarpal bone serving as a point of resistance. In taking flight from a flat surface the animal appeared to spring into the air as a lizard jumps, no one portion of the body appearing to move more than another; but it is probably true that most of the act was accomplished by the arm and forearm. In coming to rest at the end of flight the wings often remained extended for a little while; sometime one would be folded when the other was kept extended. When placed on a horizontal surface, as a table top, the animal scurried to the edge and often hung partially over. The flexible loin enabled the pelvis and lower extremities to remain on the top of the table, while the rest of the trunk was pendent on the side. A number of the bats were allowed to escape in a large room. They moved freely about the surface of a large table and made short flights to neighboring objects. No food was partaken of, and at the end of a few days they became listless and, since it was evident that they could not thrive, they were killed by immersion in spirits.

Measurements. An average taken from five individuals.

	Millimeters.
Head and body (from crown of head to base of tail).....	49
Length of arm	21
Length of forearm	40
First digit:	
Length of first metacarpal bone	3
Length of first phalanx	4
Second digit:	
Length of second metacarpal bone	38
Length of first phalanx	--
Third digit:	
Length of third metacarpal bone.....	38
Length of first phalanx	14
Length of second phalanx.....	14
Fourth digit:	
Length of fourth metacarpal bone.....	38
Length of first phalanx	12
Length of second phalanx.....	8
Fifth digit:	
Length of fifth metacarpal bone.....	24
Length of first phalanx.....	11
Length of second phalanx	5
Length of head	--
Height of ear.....	13
Height of tragus.....	4
Length of thigh	--
Length of tibia.....	11
Length of foot.....	7
Length of interfemoral membrane.....	--
Length of tail in membrane.....	15
Length of tail free from membrane.....	15

Measurements from first edition of Monograph.

Current number.	From tip of nose to tail.	Length of tail.	Length of forearm.	Length of tibia.	Length of longest finger.	Length of thumb.	Height of ear.	Height of tragus.	Expanse.	Nature of specimen.
	In.	In.	In.	In.	In.	In.	In.	In.	In.	
5253.....	2.6	1.3	1.7	0.6	3.0	0.4	0.7	0.2	11.0	Alcoholic.
5491.....	2.6	1.1	1.9	0.6	3.0	0.4	0.7	0.2	10.3	Do.
5297.....	2.6	1.0	1.7	0.6	3.2	0.3	0.6	0.2	10.0	Do.
5227.....	2.4	1.3	1.6	0.6	3.2	0.4 $\frac{1}{2}$	0.6	0.2	9.9	Do.
5219.....	2.3	1.3	1.6	0.6	3.0	0.3	0.7	0.2	10.0	Do.
	2.3	1.2	1.7	0.6	3.0	0.3	0.7	0.2	10.6	Do.
	2.0	1.3	1.6	0.5	3.0	0.3	0.7	0.2	10.4	Do.
5225.....	2.2	1.2	1.6	0.6	3.0	0.3	0.7	0.2	10.3	Do.

List of specimens.

Cat. No.	No. of specimens.	Locality.	Presented by—	Nature of specimen.	Collection.
5475..	1	Upper Rio Grande.....	Dr. T. C. Henry.....	Dry.....	U. S. N. M.
5473..	1	El Paso.....	J. H. Clark.....	do.....	Do.
5225..	1	Eastern Texas.....	do.....	Alcoholic.	Do.
5219..	3	Pecos to Rio Grande.....	Capt. J. Pope.....	do.....	Do.
5496..	2	Grand Coteau, La.....	St. Charles College.....	do.....	Do.
5223..	1	Matamoras.....	Lieut. Conch.....	do.....	Do.
5227..	1	Fort Yuma, Cal.....	Maj. G. H. Thomas.....	do.....	Do.
4742..	1	"U. S.".....	Maj. Leconte.....	Dry.....	Do.

2. *Nyctinomus macrotis nevadensis* H. Allen. (Plates XXXIV, XXXV.)

Nyctinomus macrotis Gray, Ann. Nat. Hist., iv, 1839, 5; Dobson, Proc. Zool. Soc. London, 1876, 729, Fig. 6.

Dysopes auritus Natt, Wagner, Wieg. Archiv, 1843, 368; Burmeister, Thiere Bra-siliens, 1854, 69.

Dysopes laticaudatus and *cacns* Rengger, Säugeth. Paraguay, 1800, 88.

Dysopes aurispinosus Peale, U. S. Explor. Exped., viii, 1844, 21.

Nyctinomus auritus Peters, MB. Akad. Berlin, 1865, 573.

Two specimens from Nevada in the National Museum present many characters in common with *N. macrotis*, as this species is described by Gray* and Dobson†. In both forms the ears are united by a band, the keel of auricle is curved upward and backward, the tragus is small and of the quadrate type, the ear-conch is thin and translucent, and the terminal phalanx of the fourth finger measures but 2^{mm}, and is shorter than terminal phalanx of the fifth finger. There is also a general agreement in other measurements. Nevertheless, the specimens can not be received into any of the species of *Nyctinomus* hitherto described. As compared with descriptions of *N. macrotis*, its nearest ally, the muzzle is not "concave" between the ears. The tragus is convex above instead of being "straight or concave," nor does its lower half form a "prominent angular projection." The fur, instead of being of a "reddish-brown beneath and above," is, on the dorsum, of a uniform dark plumbeous (mouse color), the base of the fur being the same as the tips. A faint line of fur extends along the forearm to the distal one-

*Ann. Nat. Hist., iv., 1839, 5.

†Cat. Chirop. Brit. Mus., 1878, 435.

fifth. The fur on the venter is slightly lighter in tint, that of the chest being a shade darker than that of the abdomen. But, on the whole, the dorsum and venter may be said to be of the same general tint. The endopatagium is without a naked space alongside the body.

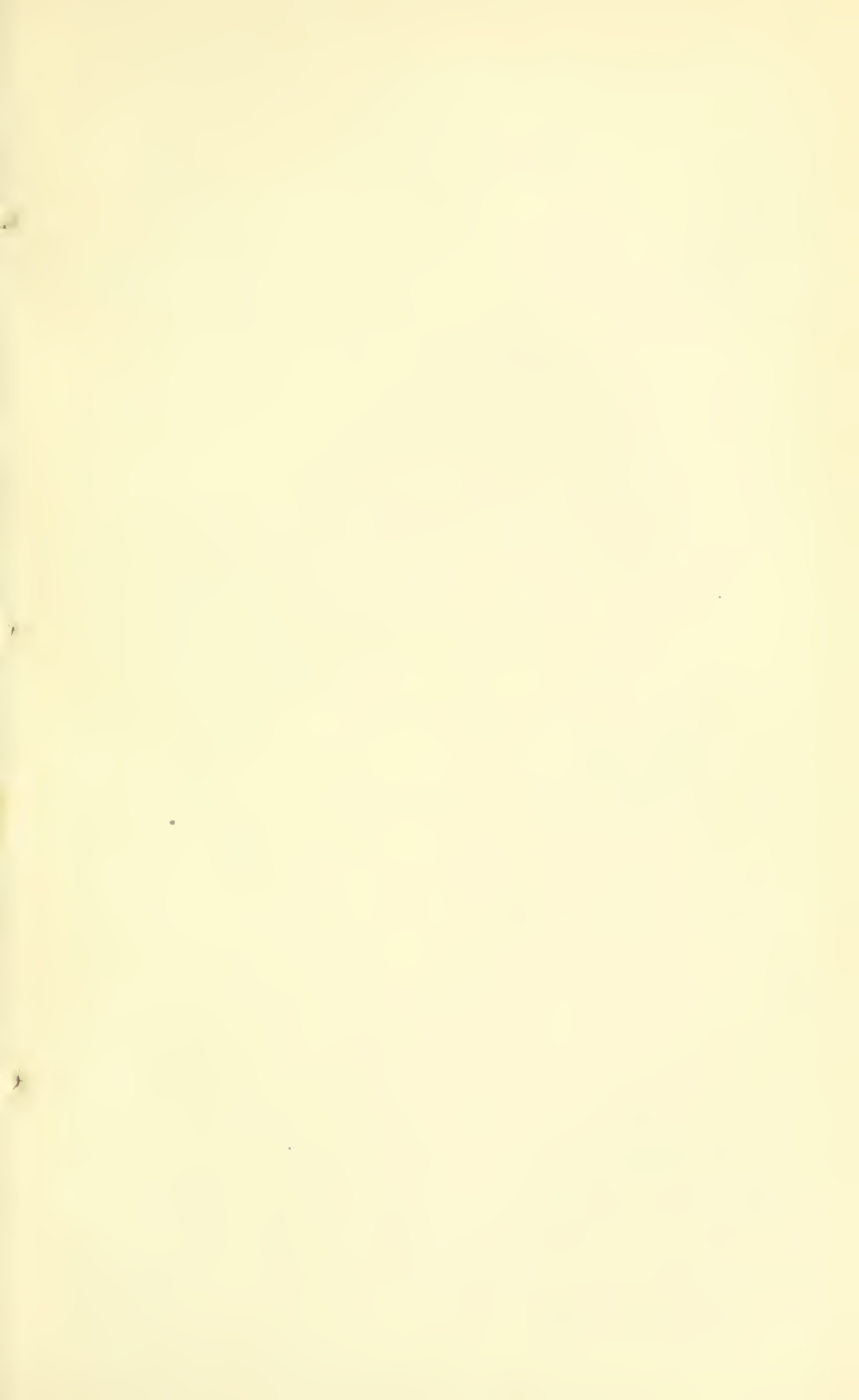
The keel of the auricle does not project outward beyond the antitragus. The manner of termination of the outer margin of the auricle on the antitragus is not described by authors. Judging from Dobson's figure (Pl. XXII, Fig. 6), the margin reaches the outer surface of the antitragus, while in the Nevada specimen it ends on the middle of the external basal process. The outer margin of the auricle is uniformly rounded.

The American species of *Nyctinomus* are not variable to any marked degree, and the characters just given are of greater significance than would be the case in some other genera. But the variations in the form of the tragus in Chiroptera are always associated with other characters; that is to say, the form of the tragus is an index to variation. The slightest modification in outline from the one accepted as typical of the species is associated with some other minor changes in the general periphery. Respecting the color, it may be said that the mouse tint of the Nevada specimens is not described in any species of *Nyctinomus*, and is therefore probably not a variation in the color of *N. macrotis*.

Description.—Muzzle with sharply defined upper borders, with deep emargination between them. The border furnished with numerous pectinate spines, except over the nostrils, where their place is taken by minute papillae. In the younger of the two specimens the muzzle presents a few scarcely discernible spines on upper border. Vertical ridge on front of muzzle papillate; in general character as in *N. brasiliensis*; well defined ridge on mentum; no submental wart apparent, but a single long hair grows from the center. The ears are thin, semi-translucent, united by a band 1^{mm} high, and a faint ridge extends 2^{mm} in front of commissure. Three small spines are seen on the internal border. The keel is 9^m long, folded back, and of the same consistence as rest of the auricle; four minute spines are seen on the upper border of the auricle. A faint, shallow scallop is seen where the revolute flange of the auricle is defined. The antitragus is broader than high, 4^{mm} at base, 2^{mm} high. The notch back of it reaches to the base of the antitragus. The inferior extremity is well defined on the venter, that is to say, that the pubo-tibial fold is absent.

The second phalanx of the fourth finger is 2^{mm} long. In this regard *N. macrotis* resembles *N. megalotis* and *N. gracilis*; and is distinguished from *N. brasiliensis*, in which this phalanx is 7^{mm} long. With Old World forms comparisons may be made with *N. pumilus* and *N. africanus*, in both of which this phalanx measures 7^{mm} in length.

The entopatagium with coraco-brachialis fascicle dividing at upper third of membrane, its anterior division reaching line of elbow and



EXPLANATION OF PLATE XXXIV.

FIG. 1. Front view of head of *Nyctinomus macrotis nevadensis*.

FIG. 2. Side view of same.

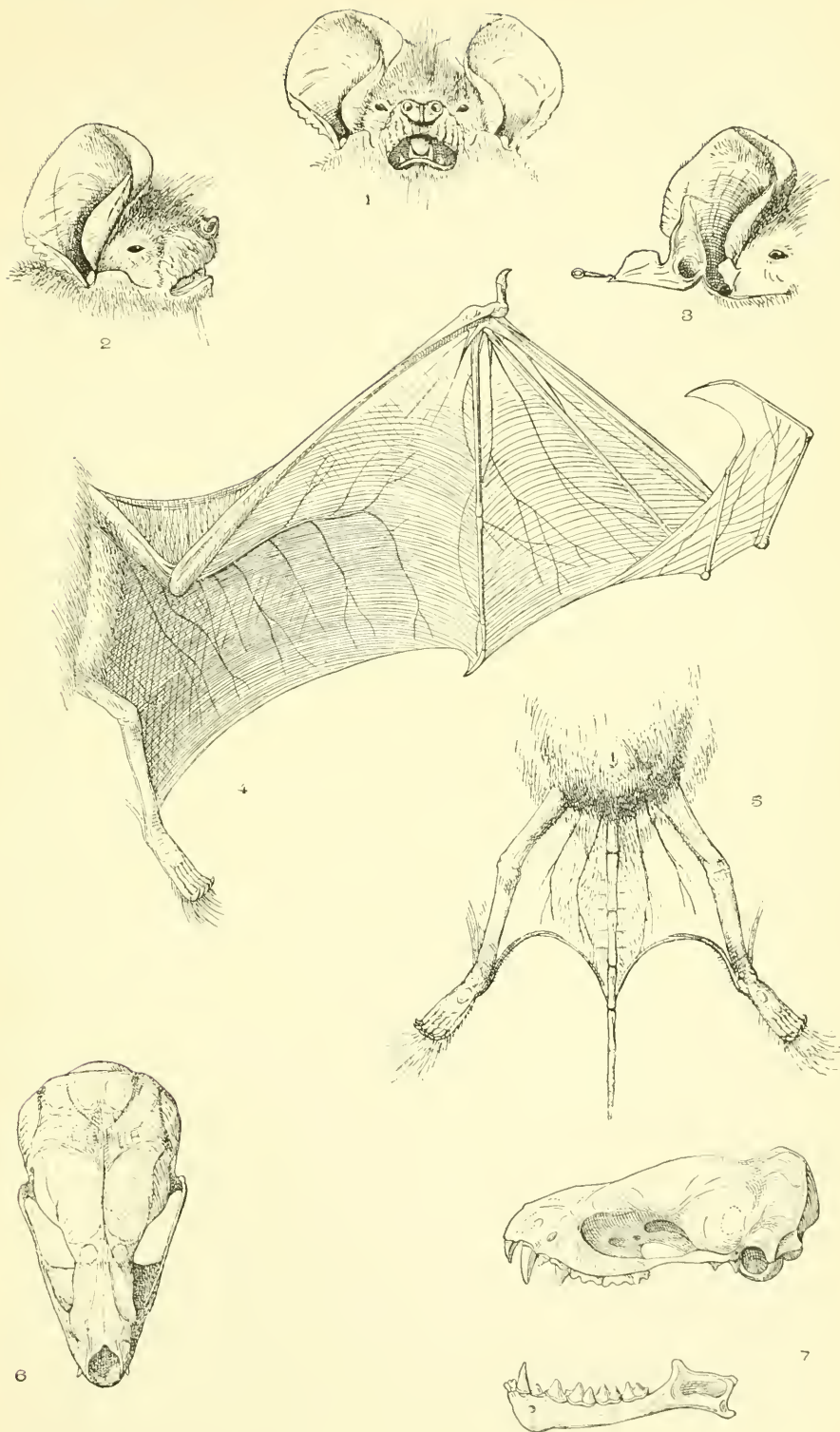
FIG. 3. View of tragus and inner surface of auricle.

FIG. 4. Wing membrane.

FIG. 5. Tail and interfemoral membrane.

FIG. 6. Skull seen from above. x 2.

FIG. 7. Skull and lower jaw seen from the side. x 2.



NYCTINOMUS MACROTIS NEVADENSIS.

extending thence vertically to within a millimeter of free margin. Other nerves of the wing membrane and the terminal phalanges as in *N. brasiliensis*. The tail membrane with a well-defined line extending from the middle of the thigh to the free margin of the membrane.

The first oblique band at the radis-carpal angle is attached to the muscle mass at the base of the fifth metacarpal bone parallel to radius. It measures 5^{mm}. The pouch is indistinct.

A fibrous band lies to the inner side of the fifth metacarpal bone. *N. brasiliensis* has none.

Maxillary teeth.—The incisor is cuspidate. The canine without posterior basal prolongation and in contact with the first premolar, which, while small in size and simple, is larger than in *N. brasiliensis* and is retained in the axis of the tooth row. The remaining teeth, as in the species last named, with the exception that the posterior limb of the second V is complete and more than half as long as the anterior limb.

Mandibular teeth.—Incisors two in number, flat crowned, deeply bilobed. The remaining teeth much the same as in *N. brasiliensis*.

Skull.—Length, 22^{mm}; mesencephalon, 5^{mm}; greatest width, 10^{mm}; least width, 4^{mm}. Length of face from infraorbital canal, 4^{mm}. The paroccipital process is broad at the base, subacuminate, not reaching to the line of the middle of the condyle and no longer than the mastoid. The interval occupied by the otic capsule, which, with the exception of a small portion crossed by a process of the squamosa, is exposed. The face vertex is scarcely inflated at its widest part, is very little wider than the region of the proencephalon. The region of the lachrymal bone is marked by a tubercle. The orbital crest is conspicuous and not produced. The line of the upper border of the anterior nasal aperture if produced would intersect the dental arch immediately back of the canine. The opening from the mesopterygoid fossa to the orbit is large. The sagittal crest is small and confined to the region of the proencephalon and metencephalon. The interval between the faintly marked posterior temporal crest and the occipital crest is elevated, rounded, and not triangular. The sphenoidal tongue is rudimental and is not disposed from the horizontal. The basisphenoid fossae is conspicuous. The tympanic bone is large and inflated; the mastoid region small, nodular; the basi occipital is narrow without lateral depressions, which are so conspicuous in *Artibeus*; the round foramen of the sphenoid bone separated from the sphenoidal foramen by a septum; the pterygoid process a delicate spine; the vomer extends to the posterior border of the hard palate.

The small coronoid is scarcely elevated above the level of the condyle, but is one-half the width of the adjacent part of the horizontal ramus. The angle is broad, flat, and scarcely produced beyond the condyle. Seen from above it is so deflected that it lies just at the outer border of the condyle. The posterior border of the ascending ramus is slightly concave. The masseteric impression is shallow and leaves a broad interval between it and the lower margin of the ramus.

Since I have never seen *Nyctinomus macrotis* in the adult form, or from localities from which it was first collected, I have thought it best to identify the specimens described as *N. macrotus nevadensis*.

In specimen No. 15178, the head and body measures 60^{mm} which is probably nearer the adult than in the preceding example. The length of the arm is 25^{mm} and that of the forearm 54^{mm}. The other measurements are not of sufficient value to be separately made.

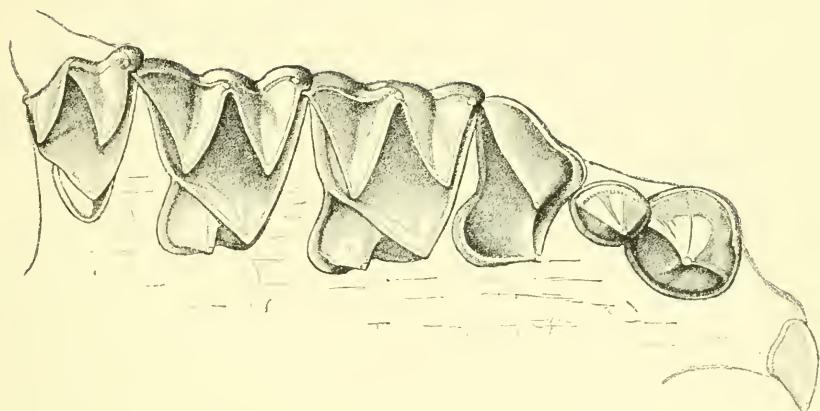
Habitat.—Nevada and California, according to Dobson, *N. macrotis* has been collected in Cuba and Brazil (Mato Grosso), and Paraguay. This writer assigns *Dysopes aurispinosus* of Peale to *N. macrotis*. In this connection it is of interest to state that Mr. Peale collected *D. aurispinosus* at sea. The specimen flew on the vessel off the coast of Brazil 100 miles from land.

MEASUREMENTS.

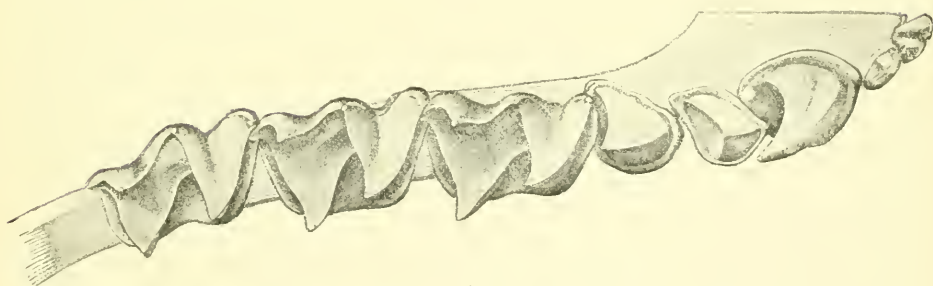
[No. 15178, U. S. N. M.]

	Millimeters.
Head and body (from crown of head to base of tail).....	
Length of arm.....	28
Length of forearm.....	52
First digit:	
Length of first metacarpal bone.....	3
Length of first phalanx.....	4
Second digit:	
Length of second metacarpal bone.....	45
Length of first phalanx.....	
Third digit:	
Length of third metacarpal bone.....	46
Length of first phalanx.....	15
Length of second phalanx.....	12
Fourth digit:	
Length of fourth metacarpal bone.....	42
Length of first phalanx.....	12
Length of second phalanx.....	2
Fifth digit:	
Length of fifth metacarpal bone.....	24
Length of first phalanx.....	15
Length of second phalanx.....	4
Length of head.....	20
Height of ear.....	15
Height of tragus.....	2
Width of tragus.....	2
Length of thigh.....	18
Length of tibia.....	13
Length of foot.....	10
Length of interfemoral membrane.....	
Length of tail entire.....	43
Length of tail (free portion).....	23

* U. S. Exploring Expedition, Mamm. and Ornith., 1848, 22.

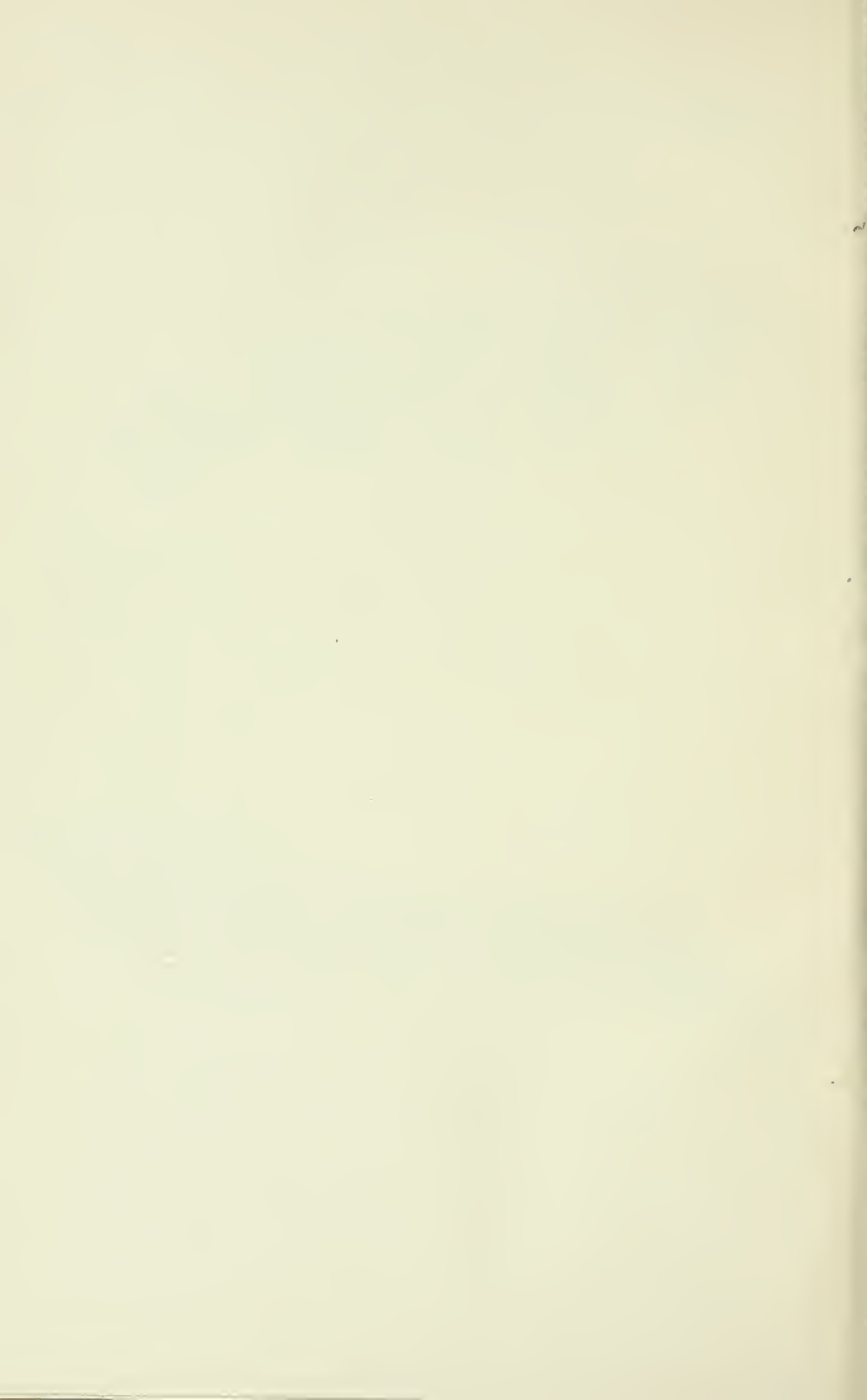


1



2

1. MAXILLARY TEETH OF NYCTINOMUS MACROTIS NEVADENSIS. X 12.
2. MANDIBULAR TEETH OF SAME. X 12.



Genus **PROMOPS** Gervais.

Promops Gervais, Exped. du Compte de Castelnau, Zoölogie, Mammifères, 1885, 59, pl. xii, figs. 3, 3a; Peters, MB. Akad. Berlin, 1865, 574.

Dental Formula.—Molars $\frac{3}{3}$, premolars $\frac{2}{2}$, canine $\frac{1}{1}$, incisors $\frac{1}{2} \times 2 = 30$.

Promops was separated by Gervais from *Molossus*, Geoff., on the presence of two premolars in the upper jaw, *Molossus* having but one.

Diagnosis.—The largest bat in the fauna, the forearm measuring $61\frac{1}{2}$ mm. Ears joined and reach forward quite to the muzzle. Protocone, without the crenulations which are so conspicuous in *Molossus rufus*. The maxillary incisors touch and occupy the intervals between the canines. The first maxillary premolar is small and withdrawn to palatal side of axis of dental series. Anterior V of first molar much smaller than the second. In common with other *Molossi* (excepting *Nyctinomus*), the premaxillæ are conjoined at the palate. The fifth digit is much the smallest of the series, and the first phalanx of the third and fourth digits is dorsiflexed in repose. The first row of phalanges in manus is from three to four times as large as the second. The fifth metacarpal bone is one-half the length of the fourth and nearly one-third the length of the third metacarpal bone.

1. *Promops perotis californicus* Merriam. (Plates XXXVI, XXXVII, XXXVIII.)

Dr. C. Hart Merriam has described a bat in the fourth fasciculus of the North American Fauna* under the name of *Molossus californicus*.† Two adult females of this bat have been forwarded to me by the National Museum, and upon these the following description has been based. I have long been familiar with a species of *Molossus* which appeared to be a distinct variety, one specimen without locality, which was sent to me by Mr. J. C. Cooper, of the California Academy of Science, and a second purchased of Mr. Ward, also without locality. One of these was in fair condition and more closely answered to the description of *M. glaucinus* than to *M. perotis*, and was identified as *M. glaucinus* var. I have not seen *M. glaucinus*, and held as probable that, as in the case of *Macrotus*, a species of Cuban bat might find closely allied forms in Mexico and California. Were it not for the fact that I have examined *M. waterhousii* from Cuba I would have hesitated in separating *M. californicus* from it. Dobson indeed does not recognize the species last named. Pursuing this plan of reasoning, I declined to describe the Californian specimen as new. Mr. Merriam has been fortunate in securing fully adult forms, which are evidently the same as my *M. glaucinus* var., and has described them under the name above given. He

*N. A. Fauna, 4, 1890-1.

†I have been acquainted with two examples of this species for a long time. One was purchased in a miscellaneous lot, and one sent for examination by the California Academy of Science. Both of these examples were without locality, and I assumed they might be member of fauna from which I had never received specimens.

makes no allusion to *M. glaucinus*, but institutes comparisons with *M. perotis*, from which it is undoubtedly distinct. In the absence of exact information respecting *M. glaucinus*, I have concluded to adopt provisionally Mr. Merriam's name as one based upon the study of the adult. Careful comparisons with *M. glaucinus* must be made before its validity is established.

M. glaucinus is stated by Dobson to be light brown at the base of the hairs, then chestnut brown, the extreme tips grayish, so that the upper surface appears altogether gray. The colors of *M. californicus* are within the group of the grays, and it is tenable that the basal shade may be variable within specific limits and pass from chestnut to buff and thence to white buff. Be this as it may, the coloration may be discarded in the diagnosis, and the important specific characters made to include the emargination on the posterior border of the auricle (which is said by Dobson to be absent in *M. glaucinus*), the presence of a tubercle on the interauricular membrane, and in the first upper premolar being central in the space between the canine and second premolar.

The tragus in *M. glaucinus*, according to Dobson, is 0.12 ($3\frac{1}{2}^{\text{mm}}$), while in *M. californicus* it is 4^{mm} , a difference so slight as to come within the range of personal error.

The difference in the measurements of the body and limbs is not greater than those between specimens of *M. perotis* in the Cambridge collection and those of the British Museum series made by Dobson.

On the dorsum the hair has sooty-ash tips, varying to a light buff or whitish; thus the hair is of two colors. The greater portion is a shade of white. The tips appear to be less differently colored from the shaft over the loin than elsewhere. On the venter the color is lighter, the tips of the hairs are less sooty, but still ashy.

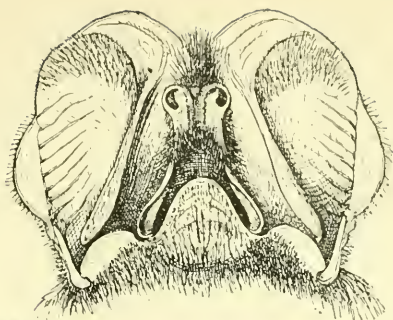
On the membranes the hair covers the basal half of the ear dorsally; it extends from the proximal third of the humerus to near the knee, and on the interfemoral membrane at the basal third. On the venter the hair is about of the same distribution as above, but they do not reach so far along the thigh, and more is found along the forearm.

A thin line of dark unicolor hair is seen along the upper border of the proximal third of the forearm in advance of the elbow; a second much larger line of similar hair extends from the proximal third of the forearm to the wrist, and a white defined patch overlies the carpal portion of the fourth digital interspace.

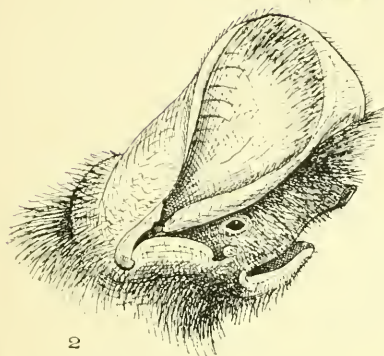
Membranes.—The prebrachium not volant beyond the junction of the proximal to the middle third of the forearm. The wing membrane is attached to the distal fourth of the leg. No. 19088, U. S. N. M., female, has a rudimentary gular pouch. Auricle ample, one-third longer than head, nearly circular, with a broad, shallow excavation on outer margin; the keel long, nearly reaching the notch, and is slightly folded forward. The hem begins at the posterior emargination, becomes gradually convex, but narrows opposite the external basal ridge, crosses the

EXPLANATION OF PLATE XXXVI.

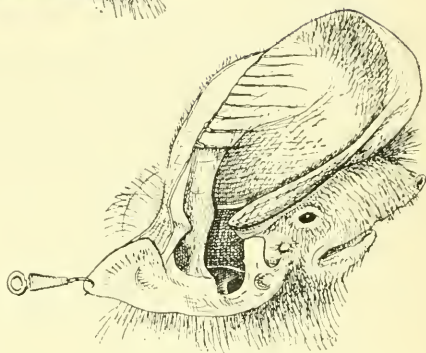
- FIG. 1. Under view of the head of *Promops perotis californicus*.
FIG. 2. Side view of same.
FIG. 3. View of tragus and inner surface of auricle.
FIG. 4. Tail and interfemoral membrane.
FIG. 5. Skull seen from above. x 2.
FIG. 6. Skull and lower jaw seen from the side. x 2.



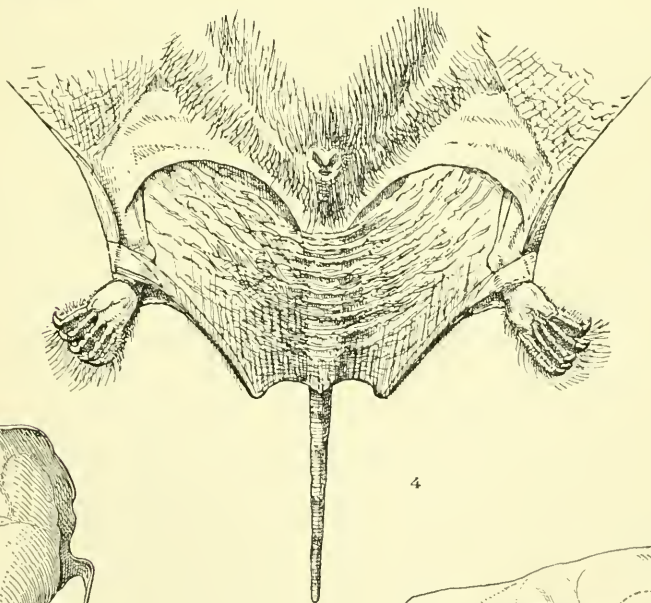
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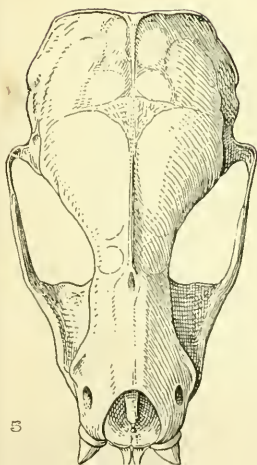
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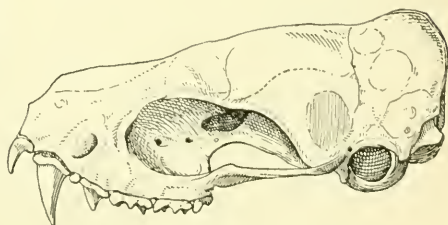
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5



6



notch, and ends on the posterior border of the antitragus. The antitragus is longer than high. The conch is very deep, almost reaching the shoulder. When the antitragus is removed from its attachments and turned outward the boundaries of the notch and the attachment are distinctly seen. The external basal ridge joins the lowest of the transverse ridges at a right angle. The tragus is longer than wide and is abruptly truncate at the apex. The interauricular membrane is deeply notched in the middle and furnished with a hairy tubercle on either side. A rib connected this membrane to the snout directly back of the muzzle. The muzzle with circular borders which are imperfectly defined below, but trenchant and project above, where they are obscurely crenulate. In the median line a vertical ridge separates the almost marginal nostrils. A sparse growth of hairs sparsely lines the upper part of interior of the auricle. A delicate fringe covers the posterior margin, including the hem. The hair of the back of the conch and base of the antitragus can not be distinguished from that of the side of the neck. The interauricular membrane is hairy on both dorsal and ventral surfaces; a moderately stiff brush of forwardly directed hairs project from the rib above the snout.

When the immense range of coloration in some bats is recalled, as for example in *Artibeus perspicillatus*, it is well to be cautious in distinguishing species by shades of fur only.

Skull.—The brain case scarcely elevated above the vertex of the face. Metencephalon slightly higher than the mesencephalon, and this in turn but little higher than the face. A slight depression only between the mesencephalon and the metencephalon. Tympanic bone not concealing cochlea. The otic capsule comes to the periphery at both squamosal bone and occiput. Semicircular canals filled with bone, save the superior, which retains a minute foramen. Anterior temporal ridge faintly marked; sagitta barely defined; posterior temporal ridge trenchant. Face vertex straight. Inner wall of the orbit nearly flat; anterior wall not depressed or with a narrow transverse groove. Anterior nasal spine with flat, thin, lateral process. The infraorbital foramen in front of the second premolar. Squama at base of zygoma is indented.

Distance from infraorbital canal to anterior nasal aperture equals twice the diameter of base of canine. Hard palate extends a short distance beyond the last molar. Lower jaw with semilunar notch exceeding the distance from angle to the condyle. The angle exceeds in length the mesolateral diameter of condyle, and lies below the lower border of the horizontal ramus. The symphyseal spine, seen from in front the symphysis menti, is crested at lower half.

The above description contrasts with *Molossus rufus* as follows: The short face vertex is abruptly inclined. The anterior temporal crest not seen, but the posterior crest and the sagitta are very large in many specimens, resembling the parts as seen in *Noctilio*.

Inner wall of orbit convex; anterior wall depressed. The anterior

nasal aperture with stout blunt process. The infraorbital canal back of the second premolar; the distance from the canal to the anterior nasal aperture equals the width of the base of the canine tooth. The hard palate does not extend beyond the last molar. The lower jaw with semilunar notch equals the distance from the angle to the condyle; the angle exceeds in length the mesolateral diameter of the condyle.

Measurements of skull.

	<i>P. perotis californicus.</i>	<i>M. rufus.</i>
	<i>Mm.</i>	<i>Mm.</i>
Greatest length.....	29	22
Length of brain case.....	17	14
Width of brain case (bimastoid).....	15	13
Width of brain case (bizygomatic).....	17	14
Width of brain case (bipreencephalic).....	5½	4½
Length of face.....	12	8

The ectoturbinal is compressed from side to side and is one-half the length of the first endoturbinal. The first endoturbinal is acuminate, as it is seen from the median surface, the portion projecting in advance of the third endoturbinal being slightly convex inferiorly. The third endoturbinal is received in a depression on the lateral surface of the first, the second being absent. It in turn receives the fourth. Both these turbinals, as seen in situ, are longer than wide.

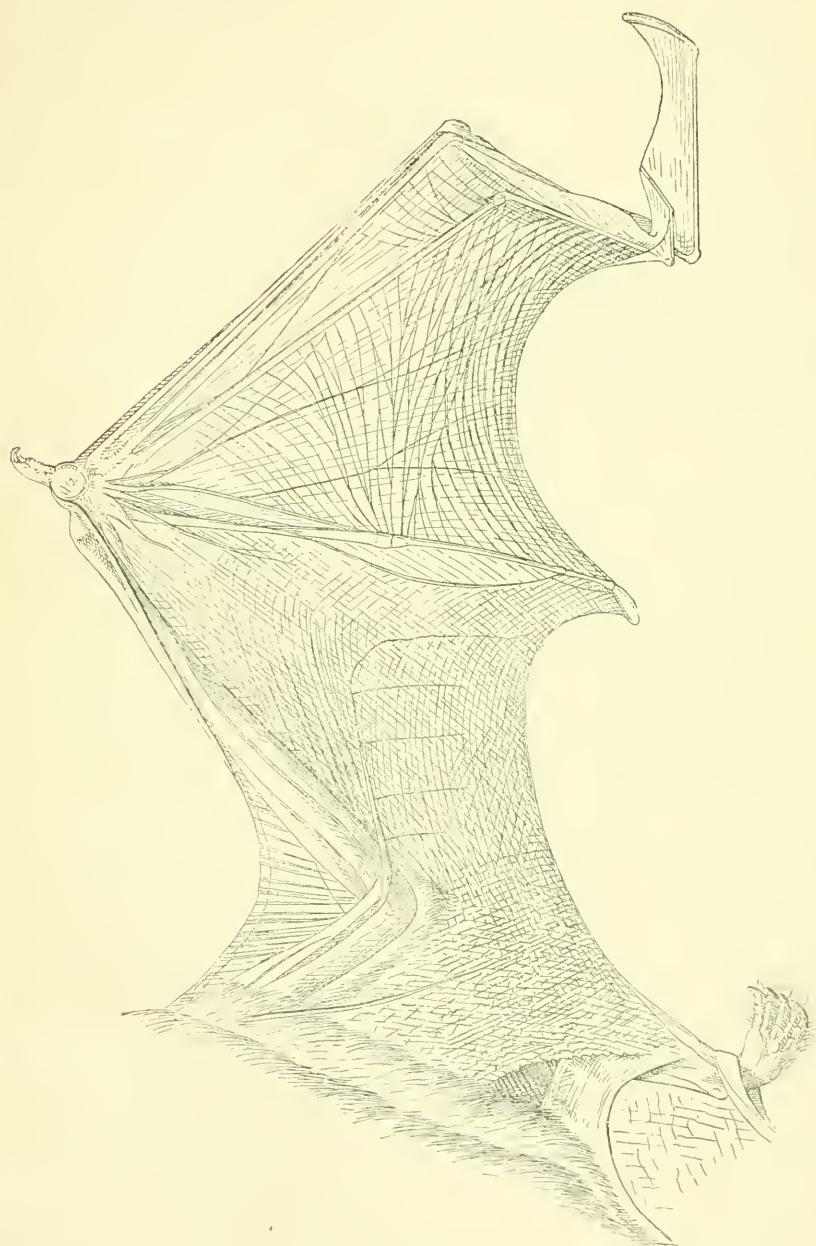
Maxillary teeth.—Incisor almost touches canine, yet reaches middle line and is contiguous with its fellow at the base. The simple, cone-like crown is thence deflected outward, causing the crowns of the two teeth to slightly diverge from one another. Canine simple without groove; the cingulum slightly produced backward. The small first premolar lies directly on the outer face of the interval between the canine and the second premolar. The second premolar with prominent paracone and large heel-like projection. The molars quite as in *Nyctinomus*, other than that the rudiment of the second V of the third molar is a mere tubercle.

Mandibular teeth.—The incisors are compressed and bilobed. The premolars are slightly crowded. The commissure at the lingual base of the heel is deeply emarginate in the middle. The heel of the third molar is somewhat compressed from without inward, the lingual border being much the higher.

Notes on the skeleton.—Axis with long transverse process, which bears a foramen to the outside of the foramen for the vertebral artery. Keel on the ventral surface of the centrum ending in a tubercle. Atlas with tubercle on anterior arc; large spine on anterior border of wide transverse process. Scapula coracoid deflected posteriorly, narrowed at end.

Humerus.—The height of the outer tuberosity correlates with the depth of the fossa in front of the head. The depression on the humerus, inner side, near elbow, equals one-half diameter of shaft. Trochlear surfaces at elbow deep, well defined.

Radius.—The depression on the radius less than that on the humerus.



WING MEMBRANE OF *PROMOPS PEROTIS CALIFORNICUS*.



The distal end of the radius is furnished with a large median process. Ulna with proximal end not anchylosed to the radius, but having an exceedingly delicate throat-like shaft which joins the radius at junction of middle with the distal, viz., at 45^{mm} the radius being 72^{mm} long. This is best seen in the young. The distal ulna element is united to the radius, forming with it a perforate quadrate plate which bears a minute perforation. The distal border of the plate is notched.

A sesamoid dorsad to first row of carpal bones; a second sesamoid on the fourth metacarpal, which is united to centrale (or magnum) by a ligament; a third sesamoid on fifth metacarpal at proximal end; it is united to the bones of the first row by a ligament.

Carpus.—The concavo-convex trapezium much larger than the small tripartite trapezoid, and overlapping it. Magnum subcordate unciform with coarsely spinose facet for the fourth metacarpal, but is plain and simple for articulation with the fifth metacarpal. Unciform, small, irregular. Pisiform not extending on shaft of the fifth metacarpal.

Metacarpus with first metacarpal, with axial facet for articulation, with a lateral facet of the second metacarpal. Second metacarpal with a large angulated head which is directed toward the fifth; the fifth metacarpal has a corresponding angulation which is directed toward the second; this arrangement greatly strengthens the palmar aspect of the carpus. The bone is compressed with sharp palmed keel much smaller than any of the series.

The differences in the length of the metacarpal and phalangeal element are seen in the table of measurements.

No keel is seen on the sternum.

Ribs are thirteen in number—the twelfth and thirteenth being widely deflected and having much larger interspaces than the others. The sacrum has three elements.

Innominate with concave dorsum anchylosed to the sacrum and to each other at the pubis.

Femur.—Internal trochanter with minute spine; external trochanter with rugose longitudinal ridge extending on proximal fourth of shaft. The line of top of the external trochanter carried across shaft lies just below head and, if produced, intersects the lower border of the free end of the internal trochanter.

Tibia, with globose spine, posterior surface of shaft near condyle depressed for flexion of toes. Fibula entire; prox end with globose extremity; distal end the larger, with well-defined malleolus. Clavicle widest to mesal half. A distinct facet is seen for articulating with the first costal cartilage.

Measurements.

Millimeters.

Head and body (from crown of head to base of tail)	70
Length of arm.....	35
Length of forearm.....	67

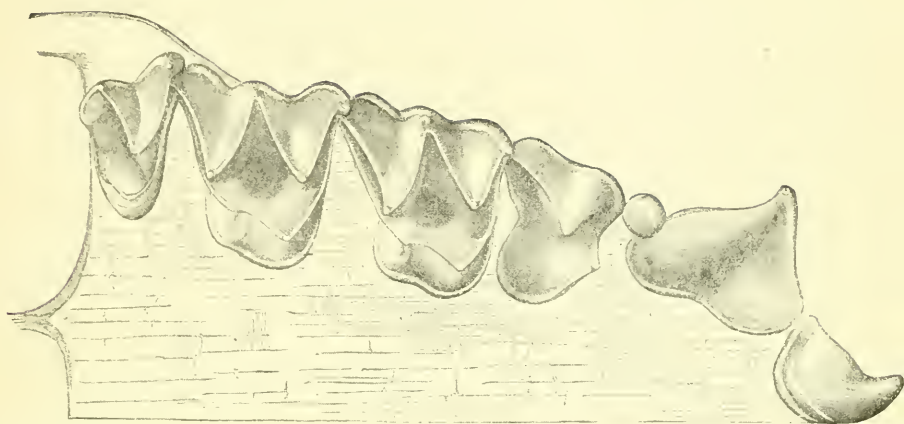
Measurements—Continued.

	Millimeters.
First digit:	
Length of first metacarpal bone.....	6
Length of first phalanx.....	6
Second digit:	
Length of second metacarpal bone.....	67
Length of first phalanx.....	2
Third digit:	
Length of third metacarpal bone.....	69
Length of first phalanx.....	30
Length of second phalanx.....	26
Fourth digit:	
Length of fourth metacarpal bone.....	66
Length of first phalanx.....	23
Length of second phalanx.....	5½
Fifth digit:	
Length of fifth metacarpal bone.....	37
Length of first phalanx.....	21
Length of second phalanx.....	6
Length of head.....	29
Height of ear (from lower border of conch).....	42
Height of ear (from vertex).....	22
Height of tragus.....	4
Length of thigh.....	18
Length of tibia.....	11
Length of foot.....	11
Length of tail in interfemoral membrane.....	22
Length of tail beyond the interfemoral membrane.....	30

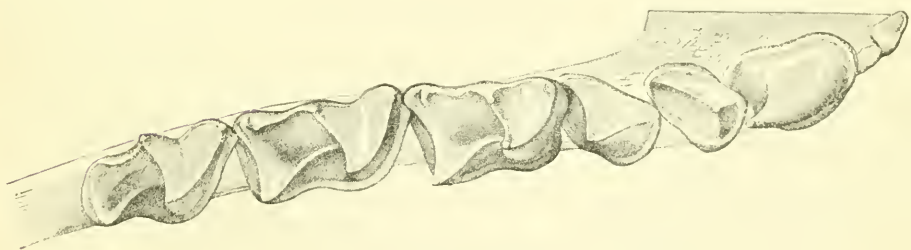
The measurements of *P. glaucinus* are here given for convenience. They have been calculated on the metric scale from Dobson's measurements on the English scale.

Measurements.

	Millimeters.
Head and body (from crown of head to base of tail).....	76
Length of forearm.....	61½
Length of first metacarpal bone.....	11
Third digit:	
Length of third metacarpal bone.....	61
Length of first phalanx.....	25
Length of second phalanx.....	27
Fourth digit:	
Length of fourth metacarpal bone.....	56
Length of first phalanx.....	21
Length of second phalanx.....	6
Fifth digit:	
Length of fifth metacarpal bone.....	29
Length of first phalanx.....	21
Length of second phalanx.....	8
Length of head.....	29
Height of ear.....	19
Height of tragus.....	3½
Length of tibia.....	16
Length of foot.....	8
Length of tail.....	63
Length of tail (free from membrane).....	25



1



2

1. MAXILLARY TEETH OF *PROMOPS PEROTIS CALIFORNICUS*. X 8.
2. MANDIBULAR TEETH OF SAME. X 8.



The closely allied *Promops perotis* should be carefully compared with the foregoing subspecies. It presents the following characters:

Ears not as high as broad. Thick at the large keel and in the region of the junction of the keel with the upper base; for the rest, thin and membranous. Hence the ear lies in the head in an irregular mass of folds. The second scallop not easily distinguished from the conch. By careful inspection a small incision is seen to lie on the outer margin at beginning of the ridge of the external basal lobe and the upper margin of the auricle. The second scallop can not be traced beyond the post-antitragus notch. The posterior border of the auricle is without emargination. The keel is much wider than in *P. californicus*. The transverse auricular line not in the form of ridges. The second scallop does not reach the antitragus, which has the same form as in *P. californicus*. The notch of the interauricular membrane is without tubercles. The snout with less sharp margin and apparently no median vertical ridge. The interauricular membrane with septum 6^{mm} behind muzzle and 6^{mm} in front of skull. Thus, the membrane lies upon the movable snout.

Antitragus twice as long as high; ridge extending forward joining the upper lip in advance of the angle. Keel fleshy, with lower third forming a lobe which is folded backward and touching the rudimental external basal lobe. A conspicuous fringe of short hair grows from conch on line of the keel. The ears are joined by a membrane, which is 3^{mm} high, and lies on the snout directly back of the muzzle. It is folded back, excepting at the median line. This membrane, together with the band for two-thirds of the posterior surface of the auricle, are thickly covered with hair. A fringe of small hairs border the auricle above the second scallop.

The tragus is twice as high as wide; nearly rectangular apex and without basal notch and lobe. The long mobile snout is one-fourth the length of the head. The upper margin of the muzzle is not found by the convex contour line as in *Nyctinomus*, but presents above it a triangular cushion, which is surrounded by long, thick hair, which fills in the interspace between the muzzle and the interauricular membrane. The upper lip is separated from the muzzle by a fringe of hair. The rictus (angle of the mouth) lies in a line with the eye.

The terminal phalanges of the manus are described as follows: Third digit, terminal phalanx compressed laterally; apex slightly expanded, triangular; no membrane on the ectal side. Fourth digit, terminal phalanx slender, aciculate, without free tip, and inclined pollical. Fifth digit, the terminal phalanx is broad, almost spatulate, the proximal half thickened, the endopatagium is attached to the base, and the membrane of the fourth interspace to its tips.

The brain.—The cerebellum is provided with a flocculus. The cerebrum is pyriform, smooth.

Sex differences.—The hair is of a brownish shade, darker in the female

than in the male. The base of the hair is pale buff to white. In the female the venter is slightly lighter than the dorsum, but in the male no appreciable difference between the regions exist. The forearm and manus with hair as in *P. perotis californicus*. Although many specimens were available for examination, but one of them, a female, was in good condition. In many the hair had been almost entirely lost, and all the specimens had been semimacerated in weak alcohol, and had been literally churned by transportation on mule back under a tropical sun.

Habitat.—Rio das Velhas, Brazil. Collected by L. Agassiz (Thayer Exped.).

Measurements.

	Millimeters.
Head and body (from crown of head to base of tail)	92
Length of arm	45
Length of forearm	79
First digit:	
Length of first metacarpal bone.....	5
Length of first phalanx	5
Second digit:	
Length of second metacarpal bone.....	71
Length of first phalanx	2
Third digit:	
Length of third metacarpal bone.....	79
Length of first phalanx	33
Length of second phalanx.....	31
Fourth digit:	
Length of fourth metacarpal bone.....	75
Length of first phalanx	26
Length of second phalanx.....	6
Fifth digit:	
Length of fifth metacarpal bone.....	42
Length of first phalanx	25
Length of second phalanx.....	7
Length of head	41
Height of ear	27
Height of tragus (posterior surface).....	6
Length of thigh	28
Length of tibia	26
Length of foot	14
Length of tail interfemoral membrane.....	42
Length of tail free from interfemoral membrane	22

Measurements of P. perotis, from Dobson.

	Inches.	Milli- meters.
Third metacarpal.....	3.5	79
First phalanx.....	1.30	33
Second phalanx.....	1.20	31
Fourth metacarpal.....	2.85	2.9
First phalanx.....	1.5	1.15
Second phalanx.....	0.25	
Fifth metacarpal.....	1.70	42
First phalanx.....	0.90	0.09
Second phalanx.....	0.25	0.35
	or 0.35	

Appendix.

In order to enable the student to decide for himself in regard to the many doubtful or unidentified species of authors cited in the foregoing pages, the descriptions themselves are reproduced in the present Appendix.

A.

RAFINESQUE.—American Monthly Magazine, III, 1818, 445.

1. *Vespertilio mystax*. R. (Whisker bat.) Tail two-fifths of total length, upper incisors none, lower 6, 2 warts at the lower jaw, body entirely fallow, top of the head brownish, ears brown, auriculated, longer than the head. Length 5 inches, breadth 14.

2. *Vespertilio humeralis*. R. (Black shoulder bat.) Tail three-sevenths, upper incisors 2, remote, lower 6, body dark brown above, shoulders black, gray beneath, wings, tail, ears and snout blackish, eyes under the hair, ears longer than the head, elliptical, auriculated. Length, 3 1-2 inches, breadth, 11.

3. *Vespertilio tessellatus*. R. (Netted bat.) Tail half of total length, hairy above, upper incisors 2, remote, lower 6, body fallow above, head pale, dirty fulvous beneath, with a faint fallow collar, shoulders white, wings hairy at the base, with 2 hairy white spots above near the thumb, membrane blackish, netted of fulvous internally and clothed of same externally, shafts fulvous, nose bilobate, ears nearly concealed by the hair. Length 4 inches, breadth 12.

4. *Vespertilio cyanopterus*. R. (Blue-wing bat.) Tail one-third, 2 incisors above, 6 beneath, body dark gray above, bluish gray beneath, wings of a dark bluish gray, shafts black, ears auriculated, longer than the head. Length 3 inches, breadth 10.

5. *Vespertilio melanotus*. R. (Black back bat.) Tail one-third, brown above, gray beneath, body blackish above, whitish beneath, wings dark gray, shafts black, ears auriculated, rounded. Length 4 1-2 inches, breadth 12 1-2.

6. *Vespertilio calcaratus*. R. (Spurred bat.) Tail one-third, body dark brown above, dark fallow beneath, wings black, shafts rose-coloured, a spur at the inner side of the elbow, hind feet black. Length 4 inches, breadth 12.

7. *Vespertilio monachus*. R. (Monk bat.) Tail one-fourth, hairy above, fringed laterally, body pale, fallow above and below, head and neck covered with a longer fur of a dark red fallow, wings dark gray, shafts red, hind feet black, nose red, ears concealed in the fur. Length 4 inches, breadth 12.

8. *Vespertilio phaiops*. R. (Black faced bat.) Tail one-third of total length, naked, mucronate, body dusky bay above, pale beneath, face, ears and wings blackish, 4 incisors in the upper jaw, 2 on each side, divided by a large flat wart, unequal, the outside ones larger and bilobed, 6 small incisors at the lower jaw. Length 4 1-2 inches, breadth 13.

9. *Vespertilio megalotis*. R. (Big-eared bat.) Tail three-eighths of total length, body dark gray above, pale gray beneath, ears very large, duplicated, auricles nearly as long. Length 4 inches, breadth 12 inches.

B

RAFINESQUE.—Annals of Nature, 1820, 2, 3.

1. N. sp. *Atalapha fuscata*. Ears longer than the head, auriculated and blackish; tail three-sevenths of total length, jutting only by an obtuse point; body brownish above, grayish beneath; shoulders and cheeks dark brown; hind feet blackish, hairy above; wings blackish brown. Found in the northern parts of the state of New York and in Vermont. Total length three and an half inches. My genus *Atalapha* (Prec. dec.) contain all the Bats without fore teeth; there are 3 or 4 species of them in the United States all blended under the name of *Vespertilio* (or *Noctilio*) *noreboracensis* by the writers.

I. N. G. EPTESICUS. Four acute fore-teeth to the upper jaw, in two equal pairs, separated by a great interval and a large flat wart, each pair has two unequal teeth, the outside tooth is much larger and unequally bifid, the outside one much larger, inside tooth small and entire. Six fore-teeth to the lower jaw, equal very small, close and truncate. Canine teeth very sharp, curved and long. Grinders unequally trifid. Snout plain, nose without appendages. Ears separated, auriculated. Tail mucronate.—This genus appears to differ from all those of Geoffroy and Cuvier, among the extensive tribe of Bats. The name means house-flyer.

2. *Eptesicus melanops*. Fallowish brown above, pale beneath, face, ears, wings, feet and tail blackish; ears oval, shorter than the head and wrinkled; tail naked, one-third of total length, mucrone one-sixth of the tail; posterior toes ciliate.—Not uncommon in Kentucky, Indiana, &c., total length, four and an half inches. I had noticed it under the head of *Vespertilio phaiops*, in the American Magazine, vol. 3d. It comes often in the house at night.

3. *Eptesicus mydas*. Fulvous above, grey beneath; wings, ears and tail, pale brown, shafts whitish; ears double the length of the head; tail naked, slightly mucronate, nearly as long as the body.—I have observed it in the barrens of Kentucky flying in the houses. Total length three inches, of which the tail includes five-twelfths. Ears three-quarters of an inch long. I mentioned it under the name of *Vesp. midas* in my account of the Bats of the Western States. (Am. Mag. v. 3). I have since instituted two other genera with them, *Hyperodon* and *Nycticeius* (Prodr. 70 N. G. An); the others are probably *Atalaphes*. I know already fifteen species of Bats in the United States, almost all new ones.

C.

LECONTE.—Cuvier's Animal Kingdom (McMurtrie's ed.), 1831, 431

I.

Vespertilio carolinensis, GEOFF. Anterior upper fore-teeth sub-simple, larger than the posterior. Remarkable for a strong odour resembling that of a Fox.

V. lucifugus, L. C.—Anterior upper fore-teeth bilobate; body above dark brown, beneath cinereous; nose sub-bilobate; face with a nakedish prominence on each side; ears oblong, naked, tragus sublinear, half as long as the ears; tail projecting a little beyond the membrane; length to the insertion of the tail, two inches and a quarter; tail, one inch and a quarter.

V. noctiragans, L. C. Anterior upper fore-teeth bilobate, the posterior sub-simple; colour black or dusty cinereous; hair on the back and belly tipped with grey; ears short, naked, roundish; tragus short and roundish; nose sub-bilobate; tail projecting a little beyond the interfemoral membrane, which is hairy; length two inches and five eighths; tail one and three eighths.

II.

Add *Plecotus macrotis*, L. C. Upper fore teeth four, trilobate, distant by pairs, the posterior smaller; ears very long, pointing forwards; tragus subulate, half the length of the ears. (There is another species with equally long ears, which are not united on the cranium; which of these is the *Megalotis*, of Rafin., it is impossible to say.)

III.

Nyct. noreboracensis. Easily known by its short and round ears, and by the inter-femoral membrane being hairy and including the whole of the tail. There is a white spot at the insertion of the wing, and another at the base of the thumb; these marks are constant. This species varies much in colour, and has been called *N. lasiurus*, Schreber, *N. monachus* by some, and is figured Wils. Orn. VI, pl. 4, whence it has been quoted by M. Cuvier as the *Taphozöus*.

Nyct. crepuscularis, L. C. Above brown, beneath paler; a small black wart above each eye; nose somewhat bilobate; chin with a small double wart; ears moderate; tragus small, subulate; tail projecting a little beyond the membrane.

Nyct. cynocephala, L. C. The posterior fore tooth on each side smaller than the rest which are emarginate; nose furnished on the top and sides with stiff short bristles; lips very large, somewhat pendulous; ears broad, round, naked; tragus not apparent; tail long, extending far beyond the membrane; outer and inner toes of the hind feet wooly on the outside; the rest with each two long hairs on the top.

D.

PALISOT DE BEAUVOIS.—Description of *Atalapha cinereus* and *Adelonycteris fuscus*. (From Pamphlet.)

Gray Bat.—Two upper teeth very small, hardly visible. Head whitish; ears round and flat, of a white color surrounded with black, and an appendage at their base; hair gray at the roots, black in the middle, and white at the ends, so that the animal has the appearance of being spotted with white. The hair extends to the membrane which surrounds the tail.

"The anterior parts of the membranous wings from the body of the projecting claw and covered with hair on both sides. This membrane is about twice the size of that in the preceding species" (*N. noreboracensis* Auct.). "The wings, extended, measure 14 inches. The nostrils are emarginated.

"Gray Bat. *N. cinereus*.

"This is found in Pennsylvania, and is not described by any author."

Brown Bat.—The two fore teeth in the upper jaw distant from one another, near the canine teeth, and about half their length; ears naked, blackish, and of an oval figure, with an appendage at their base. Tail almost as long as body; flying membrane black; hair brown on the surface, gray below.

"Brown Bat. *N. fuscus*.

"This is the most common species in the neighborhood of Philadelphia. It very much resembles the Common Bat of France, except in the number of teeth in the upper jaw."

E.

TEMMINCK.—Monographies de Mammalogie, II, 1835, 235.*

N. ursinus. (A new species kindly furnished me by Prince Max; it is based upon the examination of seven individuals.)—Head large; muzzle rather long, large, and but little depressed; nostrils large, opening upon the side and crescentic—separated by a groove. Ears ovoid, much higher than the summit of the head, the posterior border vertical, and slightly emarginated at the tip; tragus long, lamellate, but a little rounded near the tip; the auricle is hairy at the base of the external part; the thumb stout, armed by a very curved nail; tail long, point free; inter-femoral membrane marked beneath with parallel lines; claws of feet very long, stout, and curved. Incisor teeth above in two close pairs; below 6, trilobed. Molars above 4, without false; inferior with 5, one being a small false molar.

Fur long, soft, and shining; above of a brown umber hue, the inferior parts more clear. All the fur is gray at the base. Membranes and ear black.

*Translation with emendations in "Monograph of Bats of North America," Allen, 1864.

Length, 3 inches 11 lines, the tail taking $1\frac{1}{2}$ inches; length of ear, $4\frac{1}{2}$ lines; expanse of wing membrane, 10 inches 9 lines.

Hab.—Found by Prince Max upon the banks of Missouri River.

V. carolinensis.—Not so large as *V. serotinus* of Europe. Ears as long as the head, oblong, and hairy one-half the length of the external part of ears. Nose a little blunt, but nostrils approached; tragus leaf-shaped, erect, and half as long as the auricle; point of the tail free. Incisors 4, in pairs above, and 6 below. Molars 5 throughout.

Fur bicolored throughout; superior part of a brown "marron," but the base of the hair is ashy black; beneath of a yellow ash, the base of the hair being brown.

Total length, 2, 3, or 5 inches, of which the tail constitutes 1 inch; expanse, 10 inches.

Hab.—Charleston, S. C.

V. phaiops.—The general contour like that of *V. murinus*. Point of tail free; tail not so long, strongly "sloped" out on external border, with a lobe cut out behind. Tragus an erect leaf. Superior incisors, 4; the external are bilobed, and are larger than the internal. Inferior, 6. Molars, 4 above and 5 below.

Hair short and unicolored throughout, glossy, above brown, with a tinge of red, below it is of clearer hue; face and membranes blackish.

Length, 4 inches 4 lines, or 5 inches, the tail being 2 inches; expanse of wing membrane, 12 to 13 inches; antibrachium, 1 inch 8 lines.

This is the Black-faced Bat of Rafinesque, of which there is mention made in Desm. Mam. in a note.

Hab.—North America; our animal comes from Tennessee.

V. pulverulentus.—Resembles, in the color of the superior fur, *V. discolor*, but differs from it in its lesser size, in the interfemoral being hairy on both sides, and in the difference of color of the belly. Muzzle large and obtuse; ears larger than high, rounded, one-half haired; tragus hatchet-shaped; tail short; interfemoral very hairy above, but less at the point than at the base, that beneath of a clear "voie," and in concentric lines; the toes furred above.

Fur long, soft, bicolored throughout; the superior and inferior parts are of the same color. It is of a deep marron, the point only being touched with white, the hairs "clair sermes," arranged in horizontal lines upon the inferior part of the interfemoral membrane, are white.

Length, 3 inches 6 lines, of which the tail is 1 inch 3 lines; expanse, 10 inches; antibrachium, 1 inch 6 lines.

This species was furnished us by Prince Max Wied, who obtained it in the mountain recesses of North America. Ours come from the borders of Missouri.

V. caroli.—Tail the form of our *V. pipistrellus*, but the ears are longer. Face obtuse; nostrils very much separated; ears are of medium size, ovoid, slightly emarginate on their external border without having a lobe or prolongation. Upper incisors 4, in pairs above and 6 below. Molars, 6 in all; the two first false molars of the upper jaw very small, short, and pointed. Fur bicolored throughout. Face, sides of neck, and all of the superior part of a reddish brown, with black at the base; beneath of a yellowish-white at the point, with a deep brown at base, which in some parts is of a faint yellowish-ash. The young have a more somber hue. The extreme tip only of the superior parts is brown; that of the inferior is of a deep brown.

Total length, 3 inches 3 lines, the tail of which is 1 inch and 4 lines; expanse of wing membrane, 8 inches 6 lines; antibrachium, 1 inch 4 lines; height of ear from skull to the tip, 5 lines. The young have an expanse of 7 inches 10 lines to 8 inches.

The Museum has obtained from Prince de Musignano (Charles Bonaparte) many individuals of this species.

Hab.—North America, around the environs of New York and Philadelphia.

V. erythrodyctylus.—Less than the *V. pipistrellus*. The forearm, base of fingers, and the interdigital membrane of the first finger is reddish, the other membranes are black. Ears haired from their base the greater portion of their height, small, ovoidal. Tragus, subulate; tail very long, point free; interfemoral membrane haired above; beneath the hairs are arranged along the veins; it is of a silky texture, very short, and sparingly distributed. Incisors, 4, in pairs above and 6 below. Five molars in all; only one false molar in the upper jaw.

Fur long, fine, and silky; above tricolored, beneath bicolored. All the superior parts of a faint brownish red, but a little yellow about the head and neck; the hairs are black at their base, afterwards yellow, and the tip brownish red, superior part of interfemoral membrane very furry; beneath brown at base and brownish red at tip; the sides of the interfemoral covered with sparse hairs.

Length of tail, 2 inches 10 lines, or 3 inches maximum, that of tail 1 inch 4 lines; forearm, 1 inch 2 lines; expanse of wing membrane, 7 inches 6 lines, or 8 inches maximum.

The Museum du Pays Bas possesses many individuals of this supposed new species, for which we are indebted to Prince de Musignano; these specimens are preserved in alcohol, and are part of the same invoice as the preceding species. *Vesp. calcaratus*, indicated by M. Rafinesque, has the wing membranes about the fingers red above; but it is much larger and the coloration of the fur is considerably different.

Hab.—North America, about the environs of Philadelphia.

V. ferrugineus.—Style of *V. daubentonii*, of Europe. Nose short, obtuse; ears narrow, a little scooped out on the posterior border and towards the tip; tragus short, subulate. Tail very long, point free, the basal portion covered with hair; the claws of the hind feet are of a whitish yellow. Upper incisors 4, in pairs, internal long "biseam" at point; the external short, bifurcated; inferior incisors 6. Upper molars 4; lower 5, with one false molar.

Hair short, smooth, bicolored; above the color of a dead leaf, or more or less reddish; the base of the hair is of a brownish black beneath; all the hair at its base is of a faint blackish red, and the point pure white. These two hues of the hair form a sort of black and white mixture which is very conspicuous. The membranes of the ears, having been immersed in alcohol, are of a brownish red.

Total length, 4 inches or 2 lines longer, that of the tail 1 inch 9 lines; humerus, 1 inch; forearm, 1 inch 8 lines; anal expanse, 10 inches, or 6 lines longer.

This species, based upon the examination of many alcoholic specimens, is new.

Hab. Holland, Guiana. (Museum Pays Bas: from the environs of Surinam.)

F.

SAY.—Long's Expedition to the Rocky Mountains, II, 1823, 65. note.

Vespertilio subulatus.—A small bat was shot this evening, during the twilight, as it flew rapidly in various directions over the surface of the creek. It appears to be an immature specimen, as the molars are remarkably long and acute; the canines are very much incurved, and the right inferior one is singularly bifid at tip, the divisions resembling short bristles. This species is beyond a doubt distinct from the Carolina bat (*V. caroliniana*, Geoff.), with which the ears are proportionally equally elongated, and, as in that bat, a little ventricose on the anterior edge, so as almost to extend over the eye, but the tragus is much longer, narrower, and more acute, resembling that of *V. emarginatus*, Geoff., as well in form as in proportion to the length of the ear. We call it *V. subulatus*, and it may be thus described—Ears longer than broad, nearly as long as the head, hairy on the basal half, a little ventricose on the anterior edge, and extending near to the eye; tragus elongated, subulate; the hair above blackish at base, tip dull cinereous; the interfemoral membrane hairy at base, the hairs unicoloured, and a few also scattered over its surface and

along its edge, as well as that of the brachial membrane; hair beneath black, the tip yellowish-white; hind feet rather long, a few setae extending over the nails; only a minute portion of the tail protrudes beyond the membrane.

Total length, 2 9-10 inches; tail, 1 1-5 inches.

Vespertilio arquatus.—Head large; ears rather shorter than the head, wide, and at tip, rounded, hairy at base, posterior edge with two slight and very obtuse emarginations; the anterior base distant from the eye; tragus arquated, obtuse at tip; interfemoral membrane naked, including the tail to one-half of the penultimate joint. Total length, 5 inches; tail, 1 1-2 inches; expansion more than 13 inches.

Resembles *V. fuscus* in color, but larger. Ears broader and proportionally shorter, and an arquated tragus curving in an almost uniform manner towards the anterior portion of the ear, like that of *V. serotinus*. [Description abbreviated from Say.]

Council Bluffs (Iowa). Say, Long's Expedition to Rocky Mountains, 1823, I, 167.

G.

FR. CUVIER.*—Nouv. Annales du Museum d'Histoire Naturelle, Paris, 1832, 15.†

1. *Vespertilio gryphus*.—The head is like that of the *Murinoïd* group of bats, to the molars proper of which is united two additional false molars on both sides of either jaw. The ear is emarginated, and the tragus is knife-shaped. All the superior parts of the body are of a whitish yellow, the inferior parts are gray, but the base of the fur on both sides is of a blackish color. Whiskers are present on each side of the upper lip and on the extremity of the lower jaw.

Length of body, from the tip of nose to base of tail, 1 inch 9 lines; length of tail, 1 inch 7 lines; expanse of wing membranes, 7 inches 10 lines.

Hab.—Environs of New York. (M. Milbert.)

2. *V. Salarii*.—The head is like that of the *Murinoïd* group of bats, to the molars proper of which is united the presence of two false molars on both sides of either jaw. The ear is emarginate, and the tragus lanceolate. The superior parts of the body are of a brown chestnut-gray, and the inferior parts a grayish white. There is more of the brown color at the basal portion of the fur than at the upper. Whiskers are present on the sides of the upper lip and at the extremity of the lower jaw.

Length of body, from tip of nose to the base of tail, 1 inch 6 lines; length of tail, 1 inch 7 lines; expanse of wing membranes, 7 inches 7 lines.

Hab.—Environs of New York. (M. Milbert.)

3. *V. erecks*.—The head of the *Scotinoïd* group of bats. No false molars on upper jaw, and one only inferiorly; the ear is emarginate, the tragus lanceolate; the upper parts are of a brown yellow, the inferior parts of a dirty gray; the hairs of all the parts are black at their base. Whiskers are present on the sides of the muzzle and beneath upon the lower jaw.

Length of body, from tip of nose to the base of the tail, 2 inches; length of tail, 1 inch; expanse of wing membranes, 9 inches.

Hab.—Georgia. (Maj. Leconte.)

4. *V. crassus*.—The head is like that of the *Murinoïd* group of bats. Two false molars on each side of the two jaws; the ears are obtuse, the tragus is lanceolate. All the superior parts of the body of a brown chestnut-gray, and the inferior parts whitish; the fur at its base is darker tinted than its tips. Moustaches are present on the upper lip and upon the lower jaw.

Length of body, from tip of nose to base of tail, 2 inches; length of tail, 1 inch 8 lines; expanse of wing membranes, 8 inches 8 lines.

* M. Cuvier designated by the term "*Murinoïd group*" those species of Chiroptera since placed under the genus *Vespertilio*. In the "*Scotinoïd group*" he placed those species now included in *Scotophilus*. The names are taken respectively from two well-known European species—*V. murinus* and *V. serotinus*.

† Translation with emendations in "Monograph of Bats of North America," Allen, 1864.

This species was collected by M. Lesueur, who sent it from New York, under the name which I have retained.

5. *V. georgianus*.—The head is like that of the *Murinoid* group of bats. The ear is emarginate, and the tragus is subulate. All the superior parts of the body are colored by a mixture of black and whitish yellow; the black mostly, inasmuch as the points of the hair are whitish, the remainder being black. The inferior parts are gray, but mixed with black from the same cause which colors the superior portions. Mustaches are present on the sides of the upper lips and upon the lower jaw.

Length of body, from tip of nose to base of tail, 1 inch, 6 lines; length of tail, 1 inch 2 lines; expanse of wing membranes, 7 inches 2 lines.

Hab.—Georgia. (Maj. Leconte.)

6. *V. subfluvus*.—The head is like that of the *Murinoid* group of bats. The ear is emarginated, the tragus is half heart-shaped. The inferior parts of the body are of a clear whitish-gray, slightly waved with brown; the superior parts are of a white yellow; the hairs of the superior parts are black at their base, whitish through the greater part of their length, and brownish at their tips; that of the inferior parts are black at their basal portions, and of a whitish yellow at their outer. Mustaches are present on the sides of the upper lip and beneath upon the lower jaw.

Length of body, from tip of nose to the base of the tail, 1 inch 6 lines; length of the tail, 1 inch 3 lines; expanse of wing membranes, 7 inches 2 lines.

Hab.—Georgia. (Maj. Leconte.)

H.

AUDUBON and BACHMAN.—Journal, Academy of Natural Science Philadelphia, 1842, 280.

Vespertilio monticola (Mountain bat).—*V. vespertilionis* subulata brevior; auriculus brevioribus; tragus non excedentibus, dimidiam longitudinem auriculæ; colore fulvo.

Mountain Bat.—Smaller than Say's Bat (*V. subulatus*); ears shorter; tragus, less than half the length of the ear; color, yellowish brown. Upper fore teeth bilobate, ears moderate, naked, erect, rather broad at base; tragus linear, subulate, body small; wings long; tail projecting a line beyond the interfemoral membrane, which is slightly sprinkled with hair above and beneath.

Color.—The nose and chin are black; ears light brown; wing membranes dark brown. The whole of the fur of the body, above and beneath, is from the roots, of an uniform yellowish-brown color.

The species differs from Say's Bat, not only in color, but in the much shorter ears and tragus. The size and shape of the tragus we have found an invaluable guide in our American bats; the ears of the present species, when alive, are always erect; whilst those of Say's Bat are folded backwards like those of the long-eared Bats—*Plecotus*.

Dentition.—Incisors $\frac{2-2}{6}$. Canines $\frac{1-1}{1-1}$.

Dimensions.—Length of head and body, 1 inch 8 lines; length of tail, 1 inch 6 lines; length of spread, 8 inches; height of ear posteriorly, 3 lines; height of tragus, $1\frac{1}{2}$ lines.

N. B.—The tragus in Say's Bat is four-and-a-half lines in height. Several specimens of this Bat were obtained during the summer, on the mountains of Virginia, at the Grey Sulphur Springs. They were uniform in size and color.

Vespertilio virginianus (Virginian bat).—*V. vespertilionis* monticolæ paululum longior, auriculus paululum longioribus magisque acutis; dentibus primariis maxillæ superioris simplicibus; interfemorali membranâ nudâ; corpore supra fuliginoso-fusco; subtus cinereo-fusco.

Virginian bat.—A little larger than the Mountain Bat; ears a little longer and more pointed; upper fore teeth simple; interfemoral membrane naked; sooty brown above, ash brown beneath.

Dentition.—Incisors $\frac{2-2}{6}$. Canines $\frac{1-1}{1-1}$.

In size this species is intermediate between *V. carolinensis* and *V. subulatus*. The ear is naked, less rounded, and more pointed than either of the other closely allied species. The tragus is very narrow, linear, and less than half the length of the ear. The tail is inclosed in the interfemoral membrane, except the penultimate joint, which is free. The anterior upper fore teeth, instead of being sub-simple, as in the *V. carolinensis*, or bilobate, as in *V. subulatus* and *V. montanus*, are simple.

Color.—The nose, upper lip and upper jaw are black; wings dark brown. The back is sooty brown; on each shoulder, at the insertion of the wing, there is a circular black spot about 4 lines in diameter; on the under surface cinerious brown.

Dimensions.—Length of head and body, 2 inches 5 lines; length of tail, 1 inch; length of spread, 8 inches 8 lines; height of ear posteriorly, 4 lines; height of tragus, $1\frac{1}{2}$ lines.

Hab.—Mountains of Virginia.

V. leibii (Leib's bat).—*V. supra* fusco-ferrugineus, *subtus* cinereus, *alis auri* busque nigris.

Leib's bat.—Ears and wings black; dark yellowish brown above; cinereous beneath.

Description.—Anterior upper fore teeth bilobate; head short; nose blunt; ears moderate, broad at base, erect; tragus linear, nearly half the length of the ear; wings and tail long, the latter extending two lines beyond the interfemoral membrane, which is naked; feet very small; toes short and slender; nails sharp and much curved; hair soft and downy.

Color.—The ears, wings, and interfemoral membrane are black. The fur on the back is black from the roots to near the extremities, where it is so slightly tipped with light brown as to give it a dark-yellowish brown appearance. On the under surface the hairs are plumbeous at the roots, tipped with yellowish white.

Dentition.—Incisors $\frac{2-2}{6}$. Canines $\frac{1-1}{1-1}$.

Dimensions.—Length of head and body, 1 inch 7 lines; length of tail, 1 inch 4 lines; length of spread, 7 inches; height of ear posteriorly, $2\frac{1}{2}$ lines; height of tragus, 1 line.

Hab.—Michigan.

V. californicus (Californian bat).—*V. fusco* lutescens, *vellere* longo et molli; *trago* longitudine dimidium *auris* excedente.

Californian bat.—With long silky hairs; tragus more than half the length of the ear; color light yellowish brown.

Description.—Anterior upper fore teeth bilobate. Head small; nose sharp; ears of moderate size; erect, rather narrow, and pointed. Tragus linear, attenuated. Wings of moderate length, which together with the ears are naked. Interfemoral membrane with a few scattered hairs; feet small; nails slightly hooked. Tail projecting a little beyond the interfemoral membrane.

Color.—The pelage, which is unusually long for the size of the body, and very soft and glossy, is, on the upper surface, dark plumbeous from the base, and broadly tipped with light yellowish brown; on the under surface the color is a little darker, owing to the outer extremities of the hairs being more narrowly edged with the prevailing color on the back, exhibiting the darker shades beneath. The ears and tragus are blackish—the nose, chin, wings, and interfemoral membrane dark brown.

Hab.—We have obtained but a single specimen, which was captured at California.

Dentition.—Incisors $\frac{2-2}{6}$. Canines $\frac{1-1}{1-1}$.

Dimensions.—Length of head and body, 1 inch 7 lines; length of tail, 1 inch 5 lines; length of spread, 7 inches 6 lines; height of ear posteriorly, 3 lines; height of tragus, 2 lines.

I.

PRINCE MAXIMILLIAN VON WIED—Verzeich. beobach. Säugethiere in Nord Amerika, 1862, 19.*

Vespertilio brevirostris.—*Description*: Head very short; snout broad, and but little produced; ear tolerably high, rather elliptical, the anterior border somewhat rounded, the outer nearly straight, under the tip slightly emarginated; tragus rather small, nearly lancet-shaped; the fur about the head very plentiful, so that the eyes are entirely hidden.

Dentition.—The specimen of this bat is lost, so I can not therefore furnish the dentition.

The expansion of the wings rather small. Thumbs long and small, with greatly curved nails. Tail somewhat long, eight or nine joints lying on the outer half of the fur of the interfemoral membrane, the tip, however, is one and a half to two lines long, with the free points exerted; the five hind toes are long, the nails weak, and sharply curved; calcaneum rather long; fur thick about the belly, mouse-like, that of the back longer; wing membranes near the body are somewhat furred.

Coloration.—Expansion of wing membranes and ears are dark brown; upper portion of the body dark yellowish-brown, the hair on the outer half fallow yellowish-brown, dark gray at the roots; under portion whitish yellow-gray.

Measurements.—Entire length, 3 inches; expanse of wing membrane, 9 inches 4 lines; height of ears on the upper side $5\frac{1}{2}$ lines; length of the exposed portion of the tragus, $1\frac{1}{2}$ lines; the tail is free from the fur about 1 inch 5 lines; length of calcaneum, 5 lines.

I obtained this bat at Freiburg, Pa., about the latter part of July. It flies about rather early in the morning. We have observed that this bat resembles the other species closely, but it is readily distinguished by the shortness of the head, as the name given to it implies.

J.

ÉTIENNE GEOFFROY ST. HILAIRE. Annales du Muséum D'Histoire Naturelle, Paris, VIII, 1806, p. 204.

Vespertilio albesceus.—Le vespertillon poudré à l'oreille haute de 14 millimètres et de même forme que celle du V. très velu; son oreillon est de même subulé, et son pelage noirâtre en dessus et brun-obscur en dessous: il paroît comme poudré de blanc sous le ventre, parce que les pointes de chaque poil sont de cette couleur. La teinte blanche gagne de plus en plus en arrière. Ce vespertillon est la chauve-souris douzième ou la chauve-souris brune-obscur de M. d'Azzara. Il en rapporte ainsi les dimensions: longueur totale 80 millimètres; de la queue, 33, de l'envergure, 235.

[No locality is given but the statement is made that the specimen was procured by M. d'Azzara and an inference can be drawn from this fact that the type of *V. albesceus* in South America.]

K.

DOBSON.—Annals and Magazine of Natural History (1886) XVIII, 124.

Vesperugo Merriami.—The following is an abstract of Mr. Dobson's original article. *V. merriami* Dobson (Ann. and Mag., N. H., 1886, XVIII, 124), outer margin of ear less deeply emarginate than in *V. pipistrellus*, projecting part of the lower half outer margin folded backward; tragus broad, outer side upper half even convex even to broad tip. Internal margin concave, at base of outer margin a longitudinally directed lappet is seen; post calcaneal lobule shallow, extreme tip of tail alone exert. Color, pale yellowish brown on both surfaces, paler beneath, basal half or more of the hairs dusky.

* Translation in "Monograph of Bats of North America," Allen, 1864.

Upper incisors unicuspidate inner larger and thicker and lower incisors in axis of jaw. First maxillary premolar in angle not visible from without, although cusp of the second premolar is widely separated from that of the canine; the first lower premolar much shorter than the second, which considerably exceeds in height the cusps of the molars.

Measurements.—Head and body, 1'' .5; tail, 1''; head, 0'' .5; ear, 0'' .38; tragus, 0'' .18; forearm 1'' .05; pollex, 0'' .15; third finger, 1'' .6; fifth finger, 1'' .2; tibia, 0'' .4; foot, 0'' .2.

L.

SPIX.—Simiarum et Vespertilionum Brasiliensium species novæ, 1823-'63; tab. XXXVI, Fig. 8.

Vespertilio brasiliensis.—Corpore supra et subtus nigro, alis hyalinis.

Description.—Corpus exiguum; caput oblongum; rostrum prominulum, apice subobtusum; auriculæ longiusculæ, lanceolatae, versus basin sublargæ, revolutæ, versus angulum oris non excurrentes; tragus integer lanceolatus, auricularum fere longitudine; nares antice, revolutæ adlaterâ, nti et versus mentum verrucis tubuliformibus munitæ; truncus corporis supra et subtus niger; membrana alaris et interfemoralis pellucidæ, prior usque ad pollicem pedis large decurrens posterior usque ad calcaneum breviusculum et secundum caudam maiorem decurrens; cauda pede posteriorie longior, apice vix exserto ac libero.

Longitudo trunca a rostri apice usque ad caudæ initium $1\frac{1}{2}$ '', capitis $\frac{1}{2}$ '', caudæ involutæ 2'', liberæ 1'', humeri 1'', radii ultra $1\frac{3}{4}$ '', pollicis $\frac{3}{4}$ '', digiti indicis $1\frac{1}{2}$ '', medii 2'', minimi 2'', femors $\frac{1}{2}$ '', tibia $\frac{1}{2}$ '', plantæ $2\frac{1}{2}$ '', calcanei $3\frac{1}{2}$ '', membrana interfemoralis $1\frac{1}{2}$ '', auricularum ultra $\frac{1}{2}$ '', tragus ultra 2'', latitudo occipitis $\frac{1}{2}$ '', auricularum $\frac{1}{2}$ '', interseapulas $\frac{3}{4}$ '', alarum extensarum 10'', membranæ interfemoralis $1\frac{1}{2}$ ''.

M.

TRUE, Proceedings, U. S. National Museum, 1887, 515.

A note on Vesperugo hesperus (Allen).—In his monograph of the bats of North America* Dr. Harrison Allen described, under the name of *Scotophilus hesperus*, or the Western Bat, a small bat from southern California. His description was based upon four specimens, two of which (Nos. 5509, 5510, Nat. Mus.) were from Posa Creek, and a third (No. 5406, Nat. Mus.) from Fort Yuma. One of these types (No. 5509), with its skull, is still in the national collection.

Upon examining the skull of this specimen I find that Dr. Allen has apparently mistaken the character of the superior incisors, in that he describes them as "of equal length," while in reality the outer pair are only about half as long as the inner pair. Otherwise the skull agrees with Dr. Allen's description, and belongs to the genus *Vesperugo* of Keyserling and Blasius, and to the subgenus of the same name, as defined by Dr. Dobson.

The species appears to be distinct and valid. It is, however, mentioned by Dr. Dobson in his Catalogue of the Chiroptera† only in a footnote, and he is apparently doubtful of its validity. After quoting Dr. Allen's description, he writes: "The above description agrees very well with a specimen of a bat from the Straits of Juan de Fuca (Vancouver's Island), which is preserved in the collection of the Hassler Museum, near Portsmouth, and which appears to me to be identical with *V. abramus*."

At a later date this author described a new species of North American *Vesperugo*, under the name of *V. merriami*, basing his description on a single specimen sent him by Dr. C. Hart Merriam. Upon going over this description with Dr. Allen's type

* Smithsonian Misc. Coll., Vol. XI, 1864.

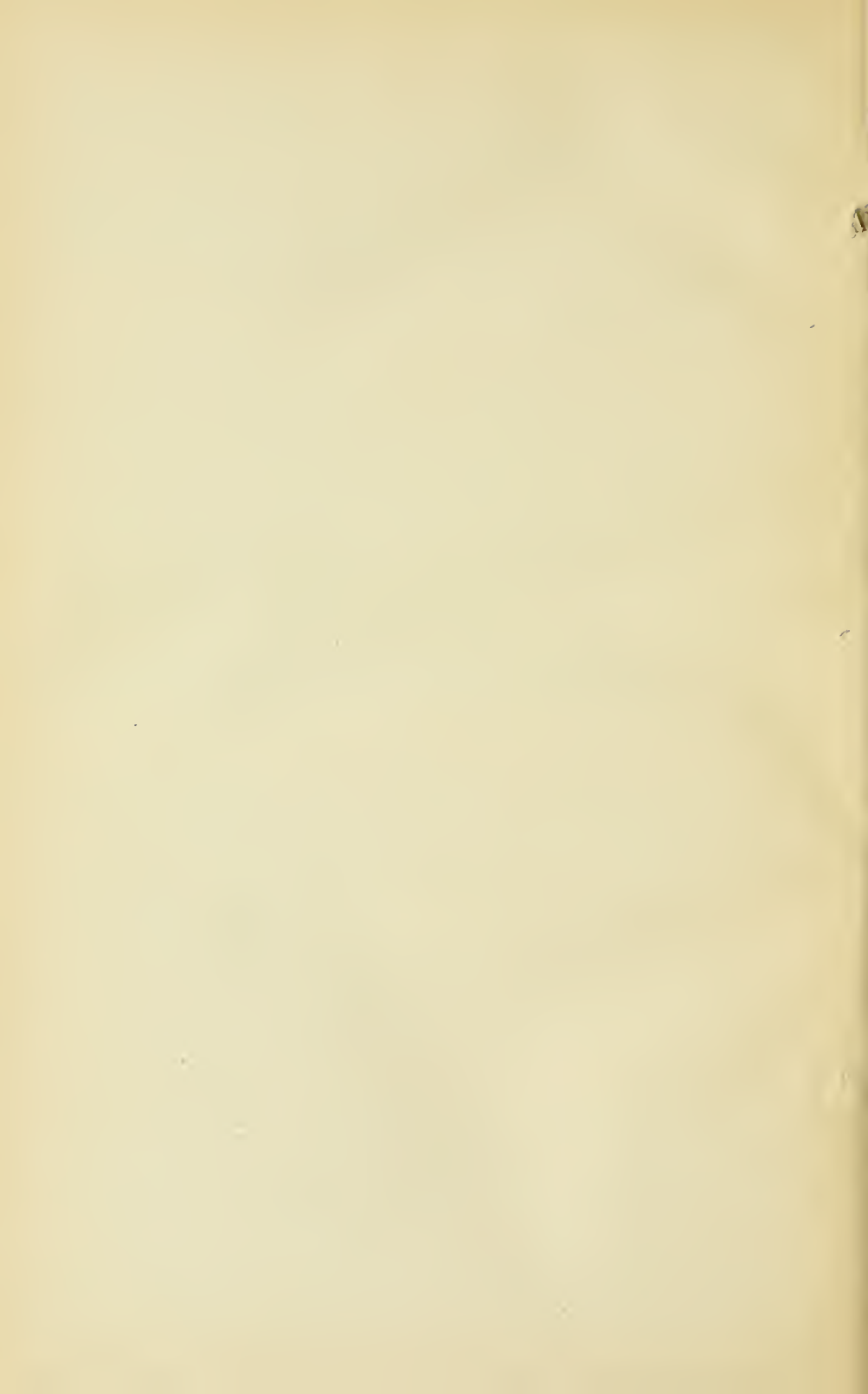
† Pages 228-229, footnote.

of *V. hesperus* and another specimen of the same (No. 15981) in hand, I find that the latter agree perfectly with the former. I have no doubt, therefore, that *V. merriami* must be regarded as identical with *V. hesperus* (Allen).

The locality given by Dr. Dobson (Locust Grove, N. Y.) is incorrect. The species is resident in the extreme southwestern section of the United States. Dr. Allen's specimens, as already stated, were from Posa Creek and Fort Yuma, Cal. Another specimen recently acquired by the National Museum (No. 15981), and referred to above, is from Whitewater, San Diego County, in the same State.

U. S. NATIONAL MUSEUM, November 21, 1887.

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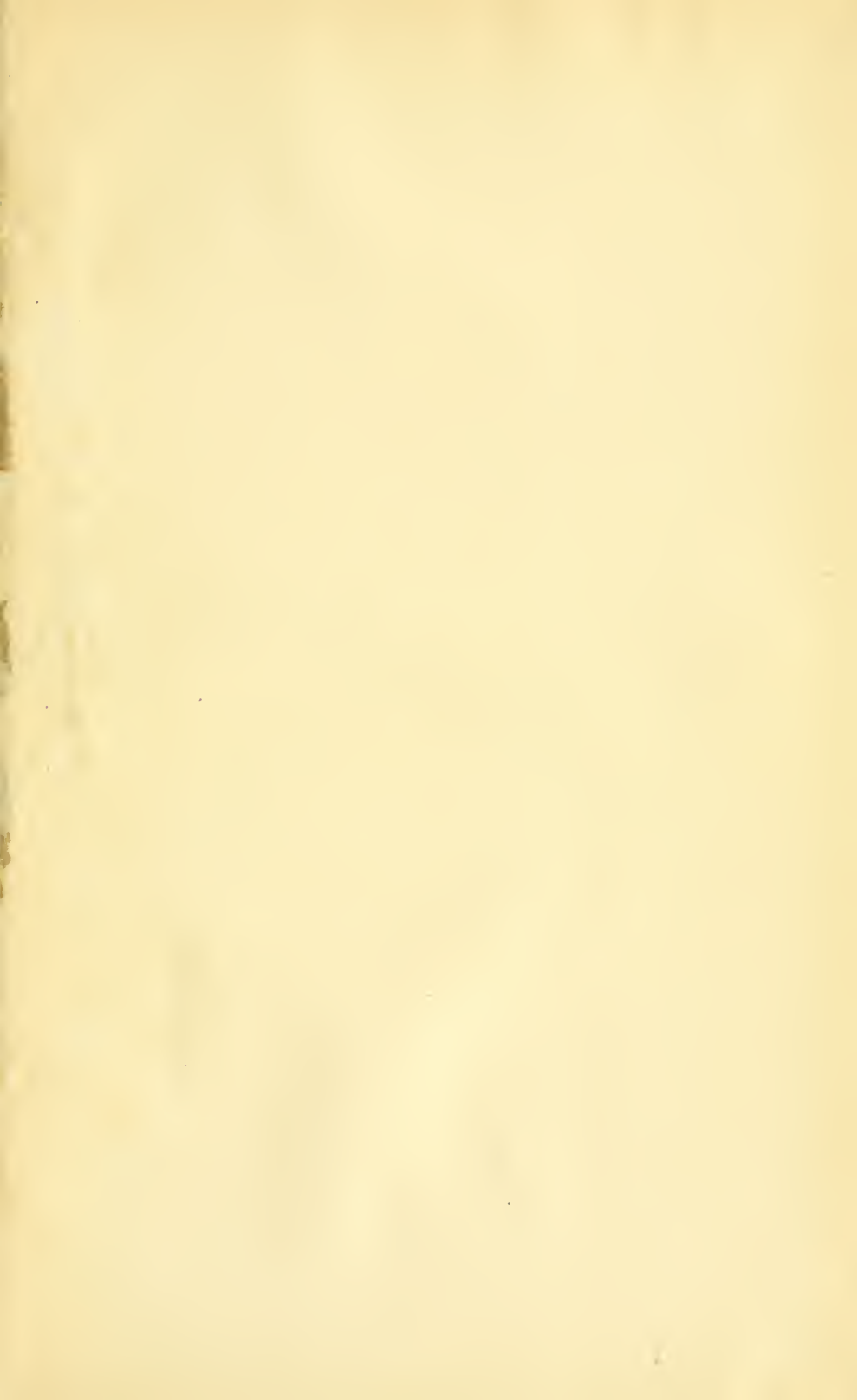
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